QUEENSLAND.

Prickly-Pear Experimental Station, Dulacca.

Report from 1st May, 1914, to 30th April, 1915.

BY

Dr. Jean White-Haney,
Officer in Charge.

(Reprint of Appendix IV. of Annual Report of Department of Public Lands for the Year 1914.)

Anthony James Cumming, Government Printer, Brisbane.

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Report of the Officer in Charge of the Prickly-Pear Experimental Station, Dulacca, from 1st May, 1914, to 30th April, 1915.

Prickly-Pear Experimental Station,

Dulacca, 30th April, 1915.

To the Chairman of the Board of Advice on Prickly-Pear Destruction.

SIR,—I have the honour to present the following report on the work performed at the Prickly-Pear Experimental Station, Dulacca, between 1st May, 1914, and 30th April, 1915.

DESTRUCTION OF DULACCA PRICKLY-PEAR BY MEANS OF POISONOUS SPECIFICS.

In my last year's report, lists were published of substances which had been proved to be injurious to the class of pear growing at Dulacca when applied as solid or liquid injections, sprays, or vapour charges, up to the date of publication of the report.*

During the year and a-half I had then been working at the experimental station, the effects of the majority of the chemical poisons known to be deleterious to plant life, and in addition many others which had not been yet proved to be poisonous to any plants, and whose cost was not sufficiently high to prohibit their use in a practical manner, had been tested.

Since that time very few specifics have been tried here. The work has been confined, for the most part, to the construction of a scale of comparisons of the damaging effects produced on the pear plants by those specifics which had already been found to be highly destructive to plants of the Dulacca pest pear. Considerable attention has also been paid to the determination of the various climatic conditions, which apparently exercise a pronounced influence on the work of pear eradication, and to the ascertainment of the minimum quantities of the specifics which are capable of producing the maximum amount of injury to the plants. The results of such poisoning experiments can necessarily be approximate only.

It is frequently an extremely difficult matter in the case of two or more badly affected plots, which have been subjected to the action of different poisons, to determine the exact degree of superiority regarding its poisoning qualifications of one specific over the others employed.

For comparative work, in order to render the comparisons of the different poisons as fair as possible, the plants selected are as nearly the same size, weight, and age as it is possible to estimate. Also, the plots to be compared are treated on the same day or on two successive days. Each result appended is the statement of the average effects of a

* Annual Report, Department of Public Lands, Queensland, for the Year 1913, pages 68 and 69.

poison on many different plots which have been treated in a similar manner. This method of taking averages is deemed necessary on consideration of the many possible circumstances which might inadvertently arise and render valueless the information obtained from one or two sets of experiments alone. The general rule adopted at this station is

PLATE 1.—Clump of Dulacca Pear weighing approximately 5 cwt. Height, 3.25 ft.; breadth, 6 ft.

to apply a certain quantity of poison per hundredweight of green pear. Necessarily the estimation of the approximate weight of the plants is in reality guesswork. At frequent intervals of time, isolated pear plants are cut down and accurately weighed, and by this means the men become fairly proficient at guessing the weight of the aerial parts of growing plants which are subjected to treatment.

The series of photographs comprised in Plates 1-5 is shown in the hope that they will prove helpful to those engaged in pear-clearing operations.

Methods of Application.

The methods employed for the application of these poisons, unless otherwise stated, are similar to those enumerated in my last report.†

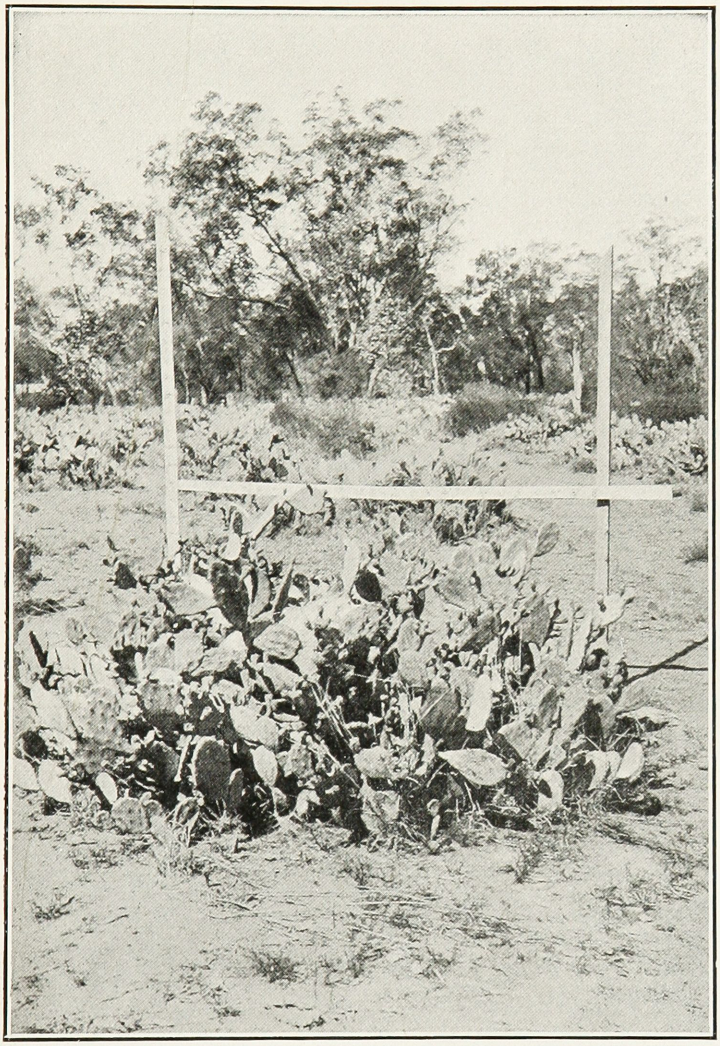

Plate 2.—Clump of Dulacca Pear weighing approximately 4 cwt. Height, 2.5 ft.; breadth, 6 ft.

In addition to the methods previously adopted, however, a fine atomiser spray has been used with favourable results. The destructive effects produced on the plants sprayed with the atomiser are more marked than they are when the ordinary spray pump is used, the same quantity of poison being applied per cwt. of pear in each case.

† Annual Report, Department of Public Lands, Queensland, for the Year 1913, pages 67 and 70.

The actual time taken for the application of the solution by means of the atomiser is, however, so much greater than when the coarser spray pump is employed that any advantage gained in efficiency by the finer distribution of the poison by the former method would for this reason be more than counterbalanced by the adoption of the latter quicker method.

PLATE 3.—Clump of Dulacca Pear weighing approximately 3 cwt. Height, 2.5 ft.; breadth, 5.25 ft.

DESIRED EFFECTS OF POISONING.

As stated in my last report,* the effect aimed at in pear destruction is the damp rotting of the plant. This condition is almost invariably followed by the collapse of the main branches, which usually become

* Annual Report, Department of Public Lands, Queensland, for the Year 1913, pages 67 and 70.

detached from the rotted bulb. Any specifics whose application is followed by this collapsed, damp, and decaying condition of the pear plants may be regarded as successful in a greater or lesser degree.

The soft unpleasant-smelling mass soon begins to dry up, and in the best work, after a few months nothing but dried skin and fibre remains. But completely successful work such as this is rather the exception than the rule in the problem of pear destruction. The marvellous

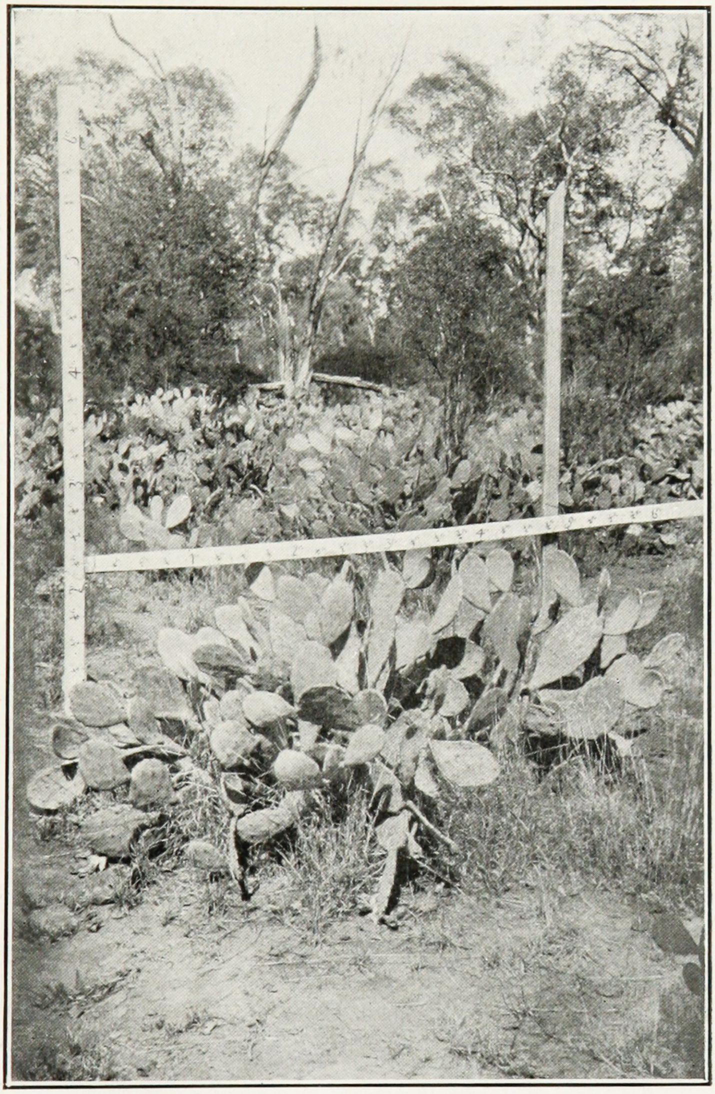

PLATE 4.—Clump of Dulacca Pear weighing approximately 2 cwt. Height, 2.25 ft.; breadth, 4.75 ft.

vitality possessed by the plants enables them to throw out new sprouts from any node in which there happens to be a few cells which have managed to escape the action of poisoning.

Though the experiments conducted at the station seem to indicate that some of these sprouts produced subsequently to poisoning may later

become affected by the poison present in the segments from which they arise to such an extent that they gradually wither and die, there is not sufficient evidence available at present to warrant the establishment of this statement as an absolute fact.

PLATE 5.—Clump of Dulacca Pear weighing approximately 1 cwt. Height, 1.5 ft.; breadth, 2.75 ft.

The lists of materials which have been proved at this station to be injurious to the Dulacca pest pear are, for convenience of reference, again set down here. Any new substances which have been tried since then have been added to the list.

Materials More or Less Injurious to Dulacca Pest Pear (in Alphabetical Order).

Injections.

Solid.

Arsenic pentoxide.
Arsenic pentoxide and copper sulphate.
Arsenic pentoxide and potassium cyanide.
Arsenic pentoxide and potassium nitrate (saltpetre).
Arsenic pentoxide and sodium chloride (salt).
Arsenic trioxide, caustic soda, and chloride of lime.
Arsenic trioxide, caustic soda, and potassium cyanide.
Arsenic trioxide, caustic soda, and salt.
Arsenic trioxide, caustic soda, and saltpetre.
Arsenic trioxide and salt.
Arsenic trioxide and washing soda.
Arsenic trioxide, washing soda, and salt.
Copper sulphate.
Mercuric oxycyanate.
Phosphorus (yellow).
Potassium bichromate.
Sodium cacodylate.
Sodium chlorate.
Sodium sulphite.

Liquid.

Antimony chloride.
Arsenic pentoxide.
Arsenic pentoxide and potassium cyanide.
Arsenic pentoxide and potassium nitrate (saltpetre).
Arsenic pentoxide and sodium chloride (salt).
Arsenic sulphide and caustic soda.
Arsenic trichloride.
Arsenic trioxide and ammonium hydroxide.
Arsenic trioxide and caustic soda.
Arsenic trioxide, caustic soda, and coal tar.
Arsenic trioxide, caustic soda, and chloride of lime.
Arsenic trioxide, caustic soda, and potassium cyanide.
Arsenic trioxide, caustic soda, and salt.
Arsenic trioxide, caustic soda, and saltpetre.
Arsenic trioxide and hydrochloric acid.
Arsenic trioxide and salt.

Injections, *Liquid*—continued.

Arsenic trioxide, salt, and sulphuric acid.
Arsenic trioxide and washing soda.
Arsenic trioxide, washing soda, and salt.
Barium chlorate.
Cacodylic acid.
Mercuric oxycyanate.
Potassium sulphocyanide.
Sodium arsenite, salt, lime, and sulphur
Sodium cacodylate.
Sodium chlorate.

Sprays.

Antimony chloride.
Arsenic pentoxide.
Arsenic pentoxide and carbolic acid (high boiling).
Arsenic pentoxide and fusel oil.
Arsenic pentoxide and potassium cyanide.
Arsenic pentoxide and potassium nitrate (saltpetre).
Arsenic pentoxide and sodium chloride (salt).
Arsenic sulphide and caustic soda.
Arsenic trichloride and hydrochloric acid.
Arsenic trichloride and methylated spirits.
Arsenic trioxide.
Arsenic trioxide and ammonium hydroxide.
Arsenic trioxide and caustic soda.
Arsenic trioxide, caustic soda, and carbolic acid.
Arsenic trioxide, caustic soda, and chloride of lime.
Arsenic trioxide, caustic soda, and potassium cyanide
Arsenic trioxide, caustic soda, and salt.
Arsenic trioxide, caustic soda, and salt petre.
Arsenic trioxide and salt.
Arsenic trioxide, salt, and sulphuric acid.
Arsenic trioxide and washing soda.
Arsenic trioxide, washing soda, and salt.

Vapour Charges.

Arsenic disulphide.
Arsenic trichloride.
Arsenic trioxide.
Arsenic trioxide and sulphur dioxide (applied separately and simultaneously to the same plants).

Since the previous publication of these lists all the specifics mentioned in them have been tried again and again. The repetition of these experiments during 1914 has naturally led to a considerable weeding-out of materials from the lists, this later work being mainly of a comparative nature. The results obtained from these more recent experiments have indicated that the following specifics have proved more beneficial for pear destruction than the others.

In each table the specifics are enumerated in order of the greatest successes achieved in the problem of pear destruction:—

Solid Injections.

Specific.	Time of Application to Plants.	Position of Injection.	Amount of Specific Applied per Plant.	Condition of Plants before Treatment	Order of Efficiency of Specifics.
Arsenic pentoxide ..	End of March, 1914	Centre of second segment from the top of a branch	9 c.c.	Very large and medium-sized	Most efficient
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. .. Saltpetre, 5 oz. ..	ditto ..	ditto	ditto ..	Large, medium-sized, and small	Second most efficient
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. .. Salt, 15 oz.	ditto ..	ditto	ditto	Medium-sized	Third most efficient
Arsenic trioxide, 12 oz. Washing soda, 4 oz. .. Salt, 15 oz.	ditto ..	ditto	ditto ..	Large, medium-sized, and small	Third most efficient
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. .. Potassium cyanide, 5oz	ditto ..	ditto	ditto	ditto	Fourth most efficient
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. .. Chloride of lime, 10 oz.	ditto ..	ditto	ditto	Large and small	Fifth most efficient
Copper sulphate ..	ditto ..	ditto	ditto	ditto ..	Sixth most efficient
Sodium cacodylate ..	ditto ..	ditto	ditto	Medium-sized and small	Seventh most efficient
Arsenic trioxide, 12 oz. Washing soda, 4 oz. ..	ditto ..	ditto	ditto ..	Large, medium-sized, and small	Eighth most efficient

Arsenic trioxide, 12 oz. Salt, 15 oz.	ditto	ditto	ditto	Medium-sized and small	Ninth most efficient
Phosphorus (yellow)	ditto	ditto	ditto	Large and small	Tenth most efficient
Potassium bichromate	ditto	ditto	ditto	Large, medium-sized, and small	Eleventh most efficient
Arsenic trioxide	ditto	ditto	ditto	ditto	Twelfth most efficient
Sodium sulphite	ditto	ditto	ditto	ditto	Thirteenth most efficient
Sodium chlorate	ditto	ditto	ditto	ditto	Fourteenth most efficient
Arsenic pentoxide	July, 1914	ditto	·5 grms. to 3 grms.	ditto	Most efficient
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. Potassium cyanide, 5 oz	ditto	ditto	4·5 grms. to 9 grms.	ditto	Second most efficient
Arsenic sulphide Caustic potash	ditto	ditto	3 grms.	Large and medium-sized	Third most efficient
Arsenic trioxide, 12 oz Caustic soda, 4 oz. Salt, 15 oz.	ditto	ditto	3·5 grms. to 5 grms.	ditto	Fourth most efficient
Arsenic trioxide, 12 oz. Washing soda, 4 oz. Salt, 15 oz.	ditto	ditto	ditto	ditto	Fifth most efficient
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. Saltpetre, 5 oz.	ditto	ditto	4·5 grms.	ditto	Sixth most efficient

LIQUID INJECTIONS.

Specific.	Time of Application to Plants.	Position of Injection.	Approximate Strength of Poison in Solution.	Amount of Solution Applied per Plant.	Condition of Plants before Treatment.	Order of Efficiency of Specifics.
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. Potassium cyanide, 5 oz.	End of March, 1914	Centre of second segment from the top of a branch	Per cent. 52·5	18 c.c.	Medium and small	Most efficient
Arsenic pentoxide	ditto	ditto	10	ditto	Large, medium-sized, and small	Second most efficient
Arsenic trichloride	ditto	ditto	Pure	ditto	Medium-sized and small	Third most efficient
Arsenic trioxide, 12 oz. Washing soda, 4 oz. Salt, 15 oz.	ditto	ditto	36·25	ditto	Large, medium-sized, and small	Fourth most efficient
Arsenic trioxide, 12 oz. Hydrochloric acid, 60 oz.	ditto	ditto	45	ditto	Medium-sized and small	Fifth most efficient
Arsenic trioxide, 15·12 oz. Ammonium hydroxide, 100 oz.	ditto	ditto	Undiluted	ditto	Large, medium-sized, and small	Sixth most efficient
Arsenic sulphide, 2 oz. Caustic soda, 1 oz.	ditto	ditto	14·8	ditto	Large, medium, and small	Seventh most efficient
Arsenic trioxide, 10 oz. Caustic soda, 4 oz.	ditto	ditto	17·5	ditto	Large, medium-sized, and small	Eighth most efficient
Arsenic trioxide, 10 oz. Washing soda, 4 oz.	ditto	ditto	ditto	ditto	ditto	Ninth most affected
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. Coal tar, ·5 pint	ditto	ditto	20·8	ditto	ditto	Tenth most affected.

Arsenic trioxide, 12 oz.. . Caustic soda, 4 oz. . . Saltpetre, 5 oz.	ditto . .	ditto	52·5	ditto . .	Medium-sized and small	Eleventh most affected
Arsenic trioxide, 10 oz.. . Caustic soda, 4 oz. . . Salt, 15 oz.	ditto . .	ditto	36·2	ditto . .	ditto . .	Twelfth most affected.
Arsenic pentoxide . .	July, 1914	ditto	16 to 25	1 to 9 grm	Large, medium-sized, and small	Most efficient
Arsenic trioxide, 10 oz.. . Caustic soda, 4 oz. . . Salt, 15 oz.	ditto . .	ditto	17·5 to 20	6 c.c. to 14 c.c.	Medium-sized and small	Second most efficient
Arsenic trioxide, 12 oz.. . Caustic soda, 4 oz. . . Potassium cyanide, 5 oz.	ditto . .	ditto	52·5	12 c.c. to 18 c.c.	Medium-sized . .	Third most efficient
Arsenic trioxide, 12 oz.. . Caustic soda, 4 oz. . . Saltpetre, 5 oz.	ditto . .	ditto	52·5	18 c.c. to 24 c.c.	ditto . .	Fourth most efficient
Arsenic trichloride . .	ditto . .	ditto	Pure . .	2·5 c.c. to 7·5 c.c.	ditto . .	Fifth most efficient
Arsenic trioxide, 40 oz.. . Caustic soda, 60 oz. . . Coal tar, ·5 pint	ditto . .	ditto	20·8	12 c.c. to 24 c.c.	Large and medium-sized	Sixth most efficient
Arsenic trioxide, 4 oz. . . Ammonium hydroxide, 850 c.c.	ditto . .	ditto	Undiluted	3·6 c.c. . .	ditto . .	Seventh most efficient

Sprays.

Specific.	Time of Application to Plants.	Approximate Strength of Poison in Solution.	Amount Sprayed per Cwt. of Pear.	Condition of Plants before Treatment.	Order of Efficiency of Specifics.
Arsenic pentoxide ..	End of March, 1914	2, 3, and 5 per cent. ..	·5 galls.	Very large ..	Most efficient
Arsenic trichloride, ·5 oz. Strong methylated spirit, 20 oz.	ditto ..	Mixture diluted to half its strength with water	ditto	Medium ..	ditto
Arsenic trichloride, 1 oz. Hydrochloric acid, 10 oz.	ditto ..	Mixture diluted with 10 oz. water	ditto	ditto ..	Second most efficient
Arsenic trioxide, 12 oz. Caustic soda, 4 oz. .. Saltpetre, 5 oz.	ditto ..	5 per cent.	ditto	ditto ..	Third most efficient
Arsenic trioxide, 4 oz. .. Salt, 10 oz. .. .. Sulphuric acid, 8 oz. ..	ditto ..	ditto	ditto	ditto ..	Fourth most efficient
Arsenic pentoxide ..	July, 1914	2, 2·5, 3, and 3·5 per cent	ditto	Large	Most efficient
Arsenic trichloride, 1 oz. Strong methylated spirits, 20 oz.	ditto ..	Mixture diluted to half its strength with water	ditto	ditto ..	Second most efficient
Arsenic trichloride, 1 oz. Hydrochloric acid, 10 oz.	ditto ..	Mixture diluted with 10 oz. water	ditto	Medium-sized ..	Third most affected

Vapour Charges.

Specific.	Time of Application to Plants.	Amount of Liquid Vaporised per Cwt. of Pear.	Condition of Plants before Treatment.	Order of Efficiency of Specifics.
Arsenic trichloride ..	Summer and autumn 1914	2 oz. or 4 oz. ..	Large, medium-sized, and small	Most efficient
Arsenic trioxide, 1 oz. .. Sulphur dioxide, 1 oz. ..	ditto	ditto ..	Medium-sized and small	Second most efficient

The Effect of Seasonal Conditions on the Process of Prickly-Pear Poisoning.

As in the previous year, two lines of small plots were treated on alternate Fridays throughout the year 1914. Each fortnightly series involved the poisoning of ten separate plots, each of which was subjected to a different mode of treatment. The series was accurately repeated each fortnight. The mode of treatment adopted for each of the ten plots was as follows:—

Plot.	Specific employed.	Mode of Application.	Strength of Solution.	Amount of Specific injected per Plant.	Amount of Specific sprayed per approximate Cwt. of Pear.	Amount of Gas evolved per approximate Cwt. of Pear.
			Per cent.			
1	Arsenic trioxide	Solid injection	..	9 c.c. in 3 injections		
2	Brünnich's arsenic mixture*	ditto ..	..	ditto		
3	Arsenic trioxide	Liquid injection	1·6	60 c.c. in 3 injections		
4	Brünnich's arsenic mixture	ditto ..	17·5	15 c.c. in 3 injections		
5	Arsenic trioxide	Spray	1·6	..	·5 gallons	
6	Brünnich's arsenic mixture	ditto ..	1·4	..	ditto ..	
7	Copper sulphate	Solid injection	..	9 c.c. in 3 injections		
8	Sodium chlorate	ditto ..	..	ditto		
9	Arsenic trioxide	Vapour charges	..	..	..	3 ounces
10	Arsenic trichloride	ditto ..	..	..	..	ditto

* Annual Report, Department of Public Lands, Queensland, 1913 page 66

Very considerable variations in the deleterious effects produced on the plants by the application of poisons at different times of the year are apparent.

The following table will serve to indicate in a general way any relation which may exist between the efficacy of the poisonous substances applied to the pear, the monthly rainfall, and the mean maximum and minimum temperatures for each month of the year 1914.

Month, 1914.	Mean Maximum Temperature per Day.	Mean Minimum Temperature per Day.	Total Rainfall per Month.	Order of Efficiency of Poisonous Specifics on Fortnightly Series of Plots.
			Points.	
January	90·9°F	68·8°F	516	Fourth most affected series.
February	86·7°F	65·0°F	155	Most affected series.
March	89·5°F	63·7°F	108·5	Second most affected series.
April	85·8°F	58·9°F	56	Sixth most affected series.
May	76·5°F	48·3°F	107	Third most affected series.
June	68·1°F	40·6°F	293	Fifth most affected series.
July	65·7°F	38·1°F	232	Eighth most affected series.
August	72·1°F	37·2°F	2	Twelfth most affected series.
September	76·8°F	45·4°F	113	Eleventh most affected series.
October	81·4°F	52·8°F	157	Ninth most affected series.
November	89·8°F	66·2°F	369	Seventh most affected series.
December	93·4°F	68·4°F	163	Tenth most affected series.

The Direct Effect of Climatic Conditions on Poison Methods of Pear Destruction.

EFFECT OF RAINFALL.

As mentioned in my last report,* all the experiments performed at the Station have led up to the conclusion that the amount of rainfall and the time at which it occurs prior to and following on the process of pear poisoning is to a large extent responsible for the degree of success achieved. Up to the time of publication of that report, the information I had been able to collect from close observation of my work was vague, and though I felt convinced of the great importance of this factor, I could only express the general principle, that in some way fairly light normal rains falling about the time of poisoning were beneficial. Another year's careful study of this branch of the work has served to indicate, in a fairly conclusive manner, that the ultimate success of the operation is largely dependent on the rainfall preceding the treatment of the plants. This statement, which even yet I do not consider has been sufficiently tested to be stated as an absolute fact, has been arrived at from the numerous and varied experiments, and a few of the data which have given rise to this conclusion are cited here.

Every plot which has been treated with arsenic acid since its first application on 12th December, 1913, was carefully examined in a relative manner recently, and the most affected and least affected plots have been singled out as examples.

Plots sprayed with arsenic acid have been selected as typical, for the purpose of illustrating the influence exerted by the rainfall on the poisoning operations.

Table illustrating the effect of rainfall on the efficacy of arsenic acid spray solution.

The plots mentioned in the table are those in which the deleterious effects of the spray are most marked.

The most seriously damaged plot is placed at the head of the list, and this order is maintained throughout the table:—

Number of Plot.	Condition of Plants.	Strength of Solution.	Amount of Solution Sprayed per Cwt. Pear.	Date of Treatment.	Last Approximate Rainfall Prior to Treatment.	Next Approximate Rainfall succeeding Treatment.
		Per cent.	Gallon.			
1413	Large and old	2·5	·5	12-12-13	7 points the previous night	196 points 7 days after
2573	Large and fairly old	2·5	·5	7-1-15	1 inch the previous night	24 points 5 days after
2580	Medium size and fairly old	1·00	·5	14-1-15	24 points 2 days before	2 points 4 days after
2345	Large and old	1·5	·5	22-1-15	25 points 5 days before	2 points on day of treatment
2352	Medium size and old	1·5	·5	20-1-15	25 points 5 days before	2 points on day of treatment
1685	Large and fairly old	5·0	·5	27-3-14	20 points the previous day	12 points 2 days after
1687	Large and old	3·0	·5	1-4-14	20 points 5 days before	9 points 12 days after
1686	Large and old	2·0	·5	27-3-14	20 points the previous day	12 points 2 days after

* Annual Report, Department of Public Lands, Queensland, 1913, page 72.

Table illustrating the effect of rainfall on the efficacy of arsenic acid spray solution. The table mentions those plots sprayed with arsenic acid solution which were affected the least of all those so treated.

Plots which have been least injured are placed first, and so on in order.

Number of Plot.	Condition of Plants.	Strength of Solution.	Amount of Solution Sprayed per Cwt. of Pear.	Date of Treatment.	Last Approximate Rainfall prior to Treatment.	Next Approximate Rainfall prior to Treatment.
			Gallon.			
Plots scattered between 2461 and 2534	Large and old, or medium-sized and fairly old	Varies between ·022 per cent. and ·5 per cent.	·5	Middle of February, 1915	25 points 5 weeks previously	22 points 2 days after
Plots scattered between 1775 and 1899	Larg, meedium-sized, and small, old and young	Varies between ·004 per cent. and 3 per cent.	·5	July, 1914	58 points about 1 week previously	48 points about 11 days after
Plots scattered between 1793 and 1899	Large, medium-sized, and small, old or young	Varies between ·004 per cent. and 4 per cent.	·5	September, 1914	About 100 points 3 days previously	About 40 points 4 weeks after

Further illustrations of the relation existing between the efficacy of poisons in destroying prickly-pear and the existing rainfall are given under the section, "Bajool Experiment."

The scarcity or abundance of rain about the time of poisoning by injection is not, apparently, such a vital consideration as it is when other modes of treatment are employed.

Though the success of the injection method is more marked when done soon after rain, the failures of those plants treated after a long period of dry weather are by no means so noticeable as are those when spraying or gas treatment are resorted to under similar climatic conditions.

In fact, a certain measure of success may be expected from injections performed throughout the year, practically regardless of the weather, with, however, the reservation that in dry periods larger quantities of poison are required to produce results of the same value as when the treatment is carried out under more favourable meteorological circumstances.

Effects of Temperature on the Operation of Pear Poisoning.

With slight variations, which, however, may be regarded as exceptions, the results of my two and a-half years' work at Dulacca indicate that the summer and early autumn, other existing conditions being favourable, are the best seasons for the application of poisonous specifics.

The effect of higher or lower temperatures is probably rather an indirect one, insomuch as it considerably influences the physiological functions of the plants, than the direct one of the actual sun's rays striking the aerial parts of the plants. From knowledge so far gained concerning the subject of the inter-relation existing between the pear-poisoning operations and prevailing climatic conditions, the destruction is found to be most complete when the poisons are applied between the middle of December and the middle of April, immediately or shortly after rain.

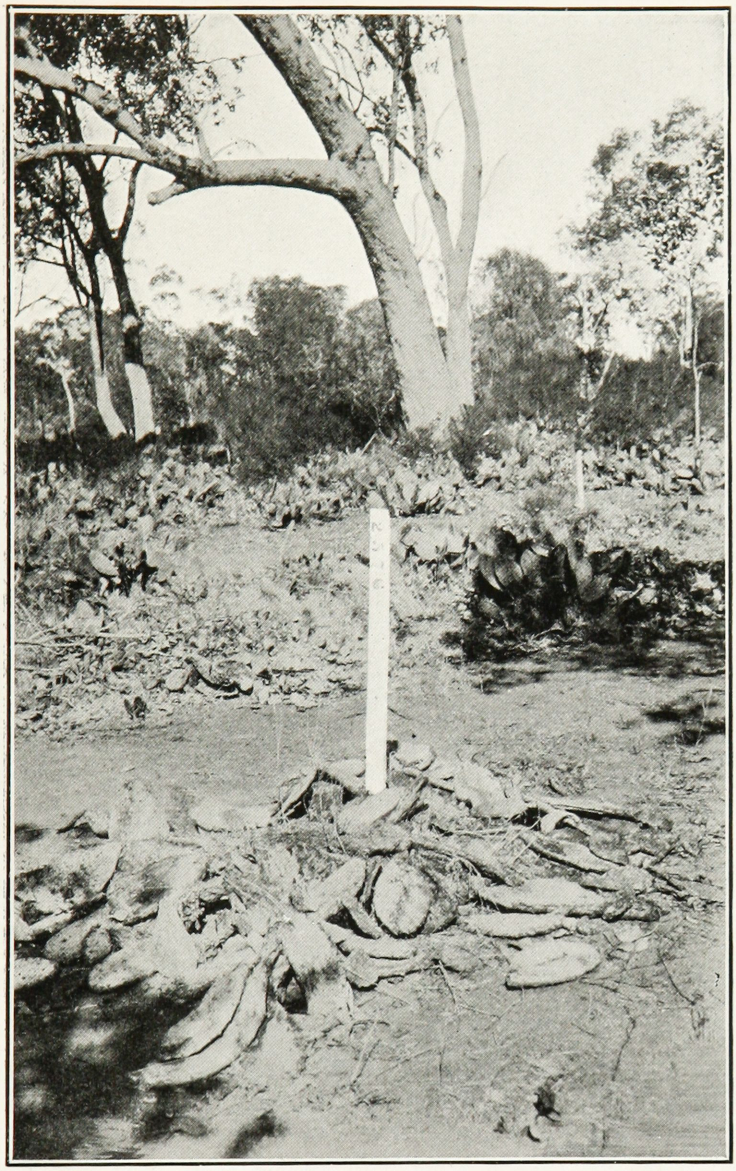

Plate 6.—Pear injected with arsenic acid. The plants injected on 12th January, 1915. 23 points of rain fell 2 days prior to poisoning, and 22 points of rain fell 4 days after poisoning.

Other External Factors which may Influence the Value of the Different Poisoning Specifics.

1.—sunlight.

Several pairs of spraying experiments, for which arsenic acid solution was the specific selected, have been performed at the Experimental Station during the last few months, with the object of determining whether the strong sunlight and heat produce any appreciable result on the ultimate effect of the application of poisons to the pear plants.

Plants were chosen as nearly alike as could conveniently be obtained,

PLATE 7.—Pear injected with arsenic acid. The plants injected on 21st January, 1915. 23 points of rain fell 9 days prior to poisoning, and 22 points of rain fell 28 days after poisoning.

and each one of a pair was treated, with one exception, in an exactly similar method, the single exception being that one was sprayed at midday on a hot day in midsummer, whilst the spraying of the other was deferred till 8 p.m. of the same day. Up till the present date, the amount of injury done to the plants by the treatment during the day is far more apparent than in those poisoned at night.

2.—METHOD OF APPLICATION OF POISONS.

As has been already stated, the chief methods of application adopted at this station are:—

(*a*) Injection of solid specific into the second segment from the top of a branch.

(*b*) Injection of a liquid specific or solution of specific into the second segment from the top of a branch.

(*c*) Spraying of a specific or a solution of specific over the aerial part of the plant by means of an ordinary spray pump.

(*d*) Spraying of a specific or a solution of specific over the aerial parts of the plant by means of an atomiser pump.

(*e*) The evolution of gas or vapour charges over the aerial parts of the plant.

These methods of application are all important, and all, with probably the exception of the atomiser spray, necessary in the colossal task of getting rid of the prickly-pear from this State.

The surest method for obtaining good results is the injection method of application. Another important advantage of this method over all the others is that it appears to be the most inexpensive.

Practically no poison is wasted, and, as in the process of injection some of the conducting channels in the pear segments are necessarily severed, there is obviously nothing to hinder the direct entrance of the poison into them.

The value of this mode of pear clearance is, however, limited, as it can only conveniently be employed in those localities in which the pear is distributed as scattered plants.

Spraying is the most convenient way of dealing with scattered clumps of pear. The effects produced on the plants after such treatment are far more variable than they are when the injection method is adopted. Further, as there is no direct means of entrance to the circulatory organs of the plants artificially created during the process, the penetration of the poison into the conducting channels of the plant is influenced to a far greater degree by external factors than it is in the case of injection, and, in addition, some proportion of the solution must unavoidably be lost. The evolution of poisonous vapours amongst the plants promises to be the best method to adopt when dealing with dense impenetrable pear. The ultimate success of this mode of treatment is apparently to a large extent dependent on the direction and force of the wind. Like the last-mentioned treatment, it is more influenced by climatic conditions than is the injection method.

The Penetration of Poisonous Specifics into the Circulatory Organs of Prickly-Pear.

It was stated in the preceding section of this Report that the actual process of injecting poisons into the pear plants involves the severing of some of the conducting channels of the plants. Consequently, an entrance into these organs of translocation is directly effected, and the consideration of the operation of injection is omitted from this section.

The usual method adopted for destruction by means of the spraying of poisonous liquids or by the evolution of noxious vapours causes the liberation of these injurious substances amongst the segments and main stems of the plants.

Plate 8.—Pear sprayed with arsenic acid, 1.5 per cent. solution, on 22nd January, 1915. 22 points of rain fell 4 days prior to treatment, and 23 points of rain fell 3 days after treatment.

Presumably, these solutions or vapours are absorbed into the interior of the segments, and are passed on from cell to cell, till finally they reach the conducting channels.

The exterior of the majority of the segments of the prickly pear is completely covered by a practically impenetrable cuticle, the thickness of which may vary to a greater or less extent in different species of pear.*

* Annual Report, Department of Public Lands, Queensland, page 76.

PLATE 9.—Pear sprayed with arsenic acid, .8 per cent. solution, on 16th February, 1915. 2 points of rain fell 29 days prior to treatment, and 22 points of rain fell 2 days after treatment.

Both surfaces of the younger segments are provided with numerous small breathing pores or stomata. These are minute openings leading from the exterior of the plant to irregular passages, interspersed amongst the internal cells of the pear segments, between which they extend for certain distances.

Each separate stoma has connected with it two guard cells, which have the power, according to surrounding conditions, of opening or

closing the stoma, and so controlling the degree of communication between the exterior and interior of the pear segments. (*See* Plate 12.)

The stomata are very numerous, there being about 20 per square millimetre of the external surface of a fairly young pear segment.

In older segments, in which, as a rule, in Dulacca pest pear, there is a certain amount of cork developed, the stomata are replaced by somewhat irregular openings called lenticels. The vital functions of the plants involve the constant intercharge of gases between the external air and the interior of the plants and *vice versâ*. Though it has been known for a long period of time that the stomata afford the chief means of entrance and exit for gases and vapours, it is probably unusual for liquids to effect an entrance through them.

Whether this is possible, is a question which has been exciting considerable interest among plant physiologists for some years. The general conclusion arrived at by them, after much attention to the subject, is that liquids may to a certain extent be absorbed by the green leaves of plants (the segments of the prickly pear plants replacing the green leaves of other plants so far as their physiological functions are concerned). On consideration of the uncertainty existing amongst botanical workers as to the possibility of the absorption of liquids from the surface of green leaves and segments, with the object of determining whether the segments or roots constitute the principal absorbing organs, the following series of three experiments was performed at this station. Three plants of Dulacca pest pear growing fairly close to each other, and of about the same size and degree of development, were selected and treated as follows:—

Plant A.—The soil under the plant, and extending for a radius of about 4 feet around it, was carefully covered with many thicknesses of hessian, which protected it from receiving any poison when the plant was sprayed.

Plant A was then sprayed with a 2·5 per cent. solution of arsenic acid, ·5 gallons being allowed per cwt. of pear.

Plant B.—This plant was sprayed in the ordinary way with a 2·5 per cent. solution of arsenic acid, ·5 gallons being allowed per cwt. of pear.

Plant C.—The whole of the exposed part of the plant was well protected from poison by being covered with many thicknesses of hessian. The surface of the soil under the plant, and for a radius of about 4 feet around it, was sprayed with a 2·5 per cent. solution of arsenic acid, ·5 gallons being allowed per cwt. of the protected bunch of pear.

At certain intervals of time after the poisoning treatment segments and parts of the roots of these three plants were forwarded to the Government Analyst of Queensland for the estimation of the quantity of arsenic which had gained entrance into each.

Detailed results of these experiments are given below.

Plant.	Condition of Experiment.	Time Poisoned.	Time Segments or Roots removed from Plant for Analysis.	Percentage of Arsenic Present in Segment Calculated as Arsenic Trioxide in Green Plant.	Percentage of Arsenic Present in Root Fragments Calculated as Arsenic Trioxide in Green Pear.	Position of Segment.
A	Plant sprayed, soil protected	1st Feb., 1915, at 4 p.m.	2nd Feb., 1915, at 4 p.m.	·0022	..	From centre of branch
B	Plant sprayed in ordinary way	ditto	ditto	·0012	..	ditto
C	Soil sprayed, plant protected	ditto	ditto	Less than ·0001	..	ditto
A	Plant sprayed, soil protected	ditto	8th Feb., 1915, at 4 p.m.	·0035	..	Top segment of branch
B	Plant sprayed in ordinary way	ditto	ditto	·0020	..	ditto
C	Soil sprayed, plant protected	ditto	ditto	·0003	..	ditto
A	Plant sprayed, soil protected	ditto	1st Mar., 1915, at 4 p.m.	·0032	·00008	ditto
B	Plant sprayed in ordinary way	ditto	ditto	·0009	·0003	ditto
C	Soil sprayed, plant protected	ditto	ditto	·00004	·0006	ditto

The above plants were examined on 12th March, and the deleterious effects produced on them as the result of spraying were disappointing; the drought conditions prevailing this year being almost certainly responsible for their partial failure. The plants labelled A and B are both dried up and withered, but are not showing signs of collapse.

There is little difference apparent in the degree of injury to the plants, though B may possibly be a shade more affected than A is. C is hardly affected at all. All are sprouting.

The interest of the series is centred on the information gained, that the great bulk of the poison is absorbed through the segments—at any rate, in the early stages after treatment. It also serves to demonstrate that the poison circulates from the segments right through the plant, from the fact that one week after poisoning the segments were found to contain less poison than they did twenty-four hours after treatment. The detection of a small trace of poison in the roots of Plant A serves to strengthen the above statement.

The behaviour of Plant C shows that a certain quantity of poison may also be directly absorbed by the root hairs, and is carried upwards to the aerial parts of the plant.

The Influence of External Conditions on the Structure and Mechanism of the Pear Plants.

A.—On the External Covering of the Segments.

1. *The Regulation of the Stomatal Opening by the Guard Cells.*

The opening or closing of the stomata is directly due to the internal condition of the guard cells. Under ordinary circumstances, the apertures are open in sunshine and in strong illumination, but are closed

PLATE 10.—Plot subjected to the fumes of arsenic trichloride, under cover on 13th March, 1914. 20 points of rain fell 4 days prior to treatment, and 20 points of rain fell 7 days after treatment.

in shade or darkness. Such plants as the prickly-pear, which are capable of surviving long periods of drought, usually also possess the power of closing their stomata when they begin to wilt.

2. *The Degree of Development of the Cuticle on the External Surfaces of the Segments.*

The more exposed the pear, the thicker is the cuticle developed. The greater reaction to poisons of the Dulacca pest pear which is growing in the brigalow shade, and of some other varieties and species of pear, is probably due to the possession of a thinner and consequently less impermeable cuticle.

Plate 11.—Plot subjected to the fumes of arsenic trichloride, under cover, on 14th August, 1914. 92 points of rain fell 20 days prior to treatment, and 96 points of rain fell 31 days after treatment.

3. *The Formation of a Layer of Protective Cork on the Surface of Segments following on Injury to the Segments.*

Immediately below the epidermis or outermost tissue of the segments is a number of cells which, in case of injury or prolonged exposure, or special strain of any kind, produce an impermeable layer of cork, which forms an adequate protection for the segments against external factors.

B.—ON THE FOOD CURRENT OF THE PLANTS.

The veins of plants are made up of channels and cells, most of which serve to convey food and food materials to all the different parts.

During winter, the vital activities of the plant are more or less suspended, and the quantity of food materials conducted through the plant is very considerably decreased, if not stopped altogether.

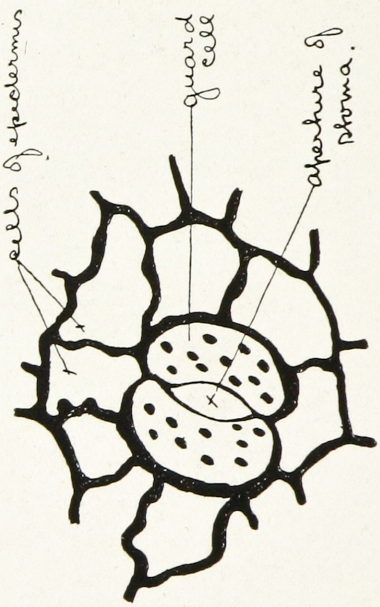

Plate 12.—Small portion of epidermis from the segment of Dulacca pest pear, showing guard cells and aperture.

With the commencement of spring, which is accompanied by a rapid production of sprouts, a strong upward current circulates from the roots and from those parts of the plant which contain stored food to the young developing sprouts.

The advent of the warmer weather consequently increases the upward flow of the sap from the roots and "bulbs" to the segments, flowers, and developing fruits.

The food materials are conveyed from the subterranean parts of the plants to the green aerial parts, in which organs they are manufactured into the different varieties of plant food such as, for example, starch and fats. On the cessation, in summer, of the most actively growing period of the plants, less food is required for immediate consumption, and the surplus quantity manufactured in the segments is stored up in the

segments, stems, "bulb," and roots. In late summer and autumn, therefore, the direction of the main currents is principally downward, towards the storage organs, till, in winter, the period of rest is established.

In some perennial plants during the colder winter months the pores in the conducting tubes of plants, through which foods pass from one part of the plant to another, become stopped up, so as to render the passage impossible. Whether these communicating pores of the conducting channels become blocked in the Dulacca pest pear during winter, is at present being ascertained from specimens which were severed from the Station plants in winter, and forwarded to the Sydney University for the purpose of this investigation. It is very probable, though insufficient research has been done in this subject to render it more than pure conjecture, that the greater measure of success which has attended the summer and early autumn poisoning treatments at the Station is to a certain extent due to:—

1. The behaviour of the stomata in warm and in cold weather.
2. The direction of the food currents which will convey poisons, which have entered the conducting channels, through the plants.

Although the circulation of food materials takes place, in a limited extent, in both directions through the plants, the greater upward flow in spring would tend to carry the poison up to the segments, while, when the downward flow in summer and autumn is the stronger current, most of the poison would be carried down towards the "bulbs" and roots, and presumably cause the more complete destruction of the plant. The complete or partial failure of the poisoning processes accomplished in summer and autumn in the absence of the usual rains could also be explained from this phenomenon—there being probably insufficient water in the plants or soil to enable the normal stream of food for storage to take place.

Poisoning of Larger Blocks.

Quarter-acre and eight-acre plots were sprayed with solutions of arsenic acid of between 2 and 2·5 per cent. strength.

Two of these were treated in September, 1914, but, like most of the other experiments performed at the Station during spring, resulted in comparative failures.

Two similar areas were treated in the same way during the latter half of February, 1915. One of these large plots, which was sprayed on 18th February, looks promising, there having been 22 points of rain the night prior to treatment. The other is apparently affected to a much smaller extent. This latter was poisoned on 24th February, six days after the rain. There has been very little rain since.

BAJOOL EXPERIMENT.

Some members of the Board of Advice on Prickly-pear Destruction suggested that the Dulacca Experimental Station should undertake the work of clearing the pear-infested portions of the Explosives Magazine Reserve at Bajool. Accordingly, I visited the reserve at the beginning of January of this year, and, after inspecting the reserve, put the clearing operations in the hands of my assistant, Mr. J. N. Eva.

Description of Reserve.

The area of the reserve is about 1,000 acres, of which approximately 600 acres are free from pear. Parts of the remaining 400 acres are covered with dense impenetrable pear, parts with densely or sparsely scattered pear, and parts with exceedingly dense and quite impenetrable scrub, amongst which the pear was found to be thickly distributed. An idea of the magnitude and position of the infested areas may be obtained from a plan prepared by Mr. Crown Lands Ranger L. G. Rawson, a copy of which is given here. (Plate 15.)

The scrub is mainly composed of masses and tangles of *Heterodendron diversifolium, Melaleuca, Lantana, Breynia oblongifolia, Acacia, Hoya australis, Lyonsia, Spartothamnus, Carissa ovata,* Belar, *Macropteranthes,* and *Opuntia.** Many of these plants are provided with thorns and prickles which greatly added to the difficulty of the work of clearing.

Variety of Pear which Infests the Bajool Reserve.

The pear here is slightly different in appearance from the Dulacca pest pear. The plants are, as a rule, higher and somewhat more delicate looking than is the Dulacca pest pear, and most of the segments, both young and old, have a fresh green colour. The majority of the older segments of the Dulacca pest pear are more or less covered with a layer of brownish cork, which apparently adds considerably to their powers of resistance.

Another difference which immediately attracts notice is that the main stem in the Bajool variety does not usually branch so close to the ground as it does in Dulacca pear. These differences are exaggerated in the plants distributed through the scrub at Bajool. Specimens of the pear growing in the Magazine Reserve were forwarded for identification to Mr. J. H. Maiden, of the Sydney Botanic Gardens, who writes:—"It is a plant whose position appears to be somewhat uncertain, and I cannot at present state whether I think it should be removed from *inermis* or whether it is only an extreme form of that species." The species *inermis* in this case refers to the pest pear of Dulacca.

The Specific Employed and the Method of Application.

Throughout the experiment the specific employed was a crude form of arsenic acid, of which 8 cwt. were obtained from the Victor Leggo Chemical Company of Victoria. Samples of the poison were sent for analysis to the Government Analyst, Brisbane, and were found to contain 80 per cent. of arsenic acid. Spraying was the method adopted almost exclusively for the application of the arsenic acid. The strength of solution employed varied between 1·8 per cent., which was the weakest solution, and 2·3 per cent., which was the strongest solution used. Samples of every solution applied were forwarded for verification to the Government Analyst, Brisbane.

The spraying apparatus employed throughout was Kirby's "Uneeda" hand pump, which is convenient in such class of country, where hand spraying has to be resorted to.

The total weight of pear which was subjected to the poison was

* These plants were kindly identified by the Colonial Botanist, Brisbane.

approximately 7,250·1 cwt.; total number gallons of spray mixture applied is 3,625·5 gallons, containing 896 lb. approximately of crude arsenic acid. The pear in a few acres of land in the open forest portion of Section 125 was injected with the same specific in an undiluted state.

The weight of pear treated in this manner was approximately 73·75 cwt., and the quantity of poison applied per cwt. of pear was approximately 2 grains.

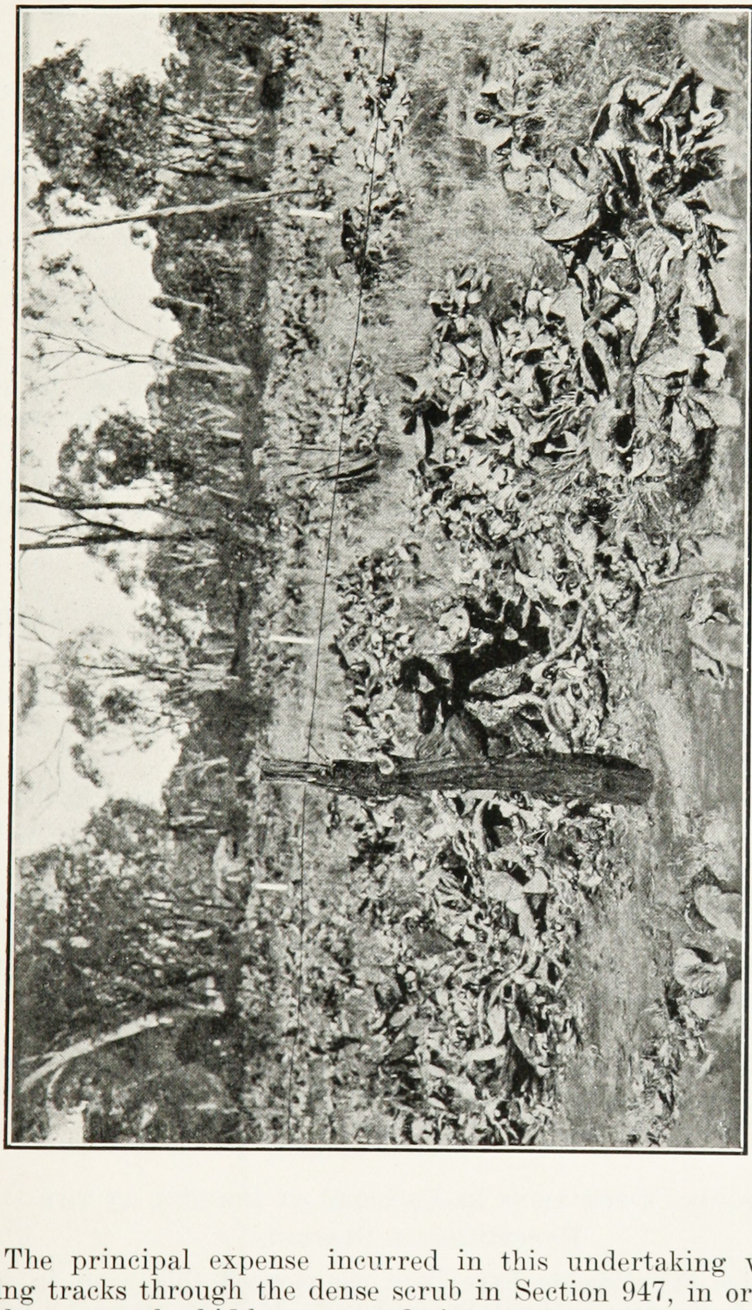

PLATE 13.—Plot (size, .125 acre) 8 weeks after spraying with 2.5 per cent. solution of arsenic acid. The poison was applied on 18th February, 1915. 22 points of rain fell the night prior to treatment, and 23 points of rain fell 8 days after treatment.

The principal expense incurred in this undertaking was that of cutting tracks through the dense scrub in Section 947, in order to sufficiently expose the hidden pear. Owing to the inability of obtaining a further supply of arsenic pentoxide during the months favourable to pear

poisoning, the operations were suspended on 27th February, when our supply of arsenic pentoxide was exhausted, until next summer.

The following table gives the details of the spraying operations performed:—

Cwt. of Pear Treated.	Tons of Pear Treated.	Gallons of Spray Solution Used.	Pounds of Crude As_2O_5 Used.	Pounds of Spray Solution Used.
Approximate.	Approximate.		As_2O_5.	Mixture.
7251·1	362·55	3625·55	896	·36255

During this month I visited the scene of the poisoning operations at Bajool, accompanied by two members of the Board of Advice on Prickly Pear Destruction. The work of spraying in February had been interrupted owing to heavy rains, 7 inches being registered in thirty-six hours. Previous to this downpour there had been no rain there for a considerable time. Slightly more than half of the pear treated was done before the rain. There is a striking difference in the appearance of the plants sprayed before and after the rain. The former have not collapsed to any marked extent, and are mostly exhibiting numbers of vigorous new sprouts. The majority of the plants treated after rain, however, have wholly or partially collapsed, forming damp, rotting masses, on which new green sprouts are extremely rare, though a very few were noted on the rotted segments. None of these new sprouts look healthy. On the whole, I consider the results obtained from this experiment as fairly satisfactory, more especially as emphasising the importance of the rainfall on the operation of pear poisoning.

Conclusions Drawn from the Various Poisoning Experiments already Performed at the Experimental Station.

The results furnished by the poisoning experiments carried on at the Experimental Station up to the present date have led to the following provisional conclusions:—

1. The most effective specific yet applied to the plants in the form of solid injections, liquid injections, or spray is arsenic acid. (Arsenic pentoxide.)
2. The most effective gas treatment is produced by the fumes of arsenic trichloride.
3. The best season for the application of poisoning by any of the previously mentioned methods is during the summer and early autumn.
4. The success of the undertaking is largely dependent on the rainfall prior to and after poisoning, probably more especially on the former.

Poisoning Operations in Progress at Present at the Experimental Station.

Extensive experiments have been commenced this year, in which arsenic acid is the principal poison employed. It is the extreme solubility of this substance in water on which its success regarding its pear-

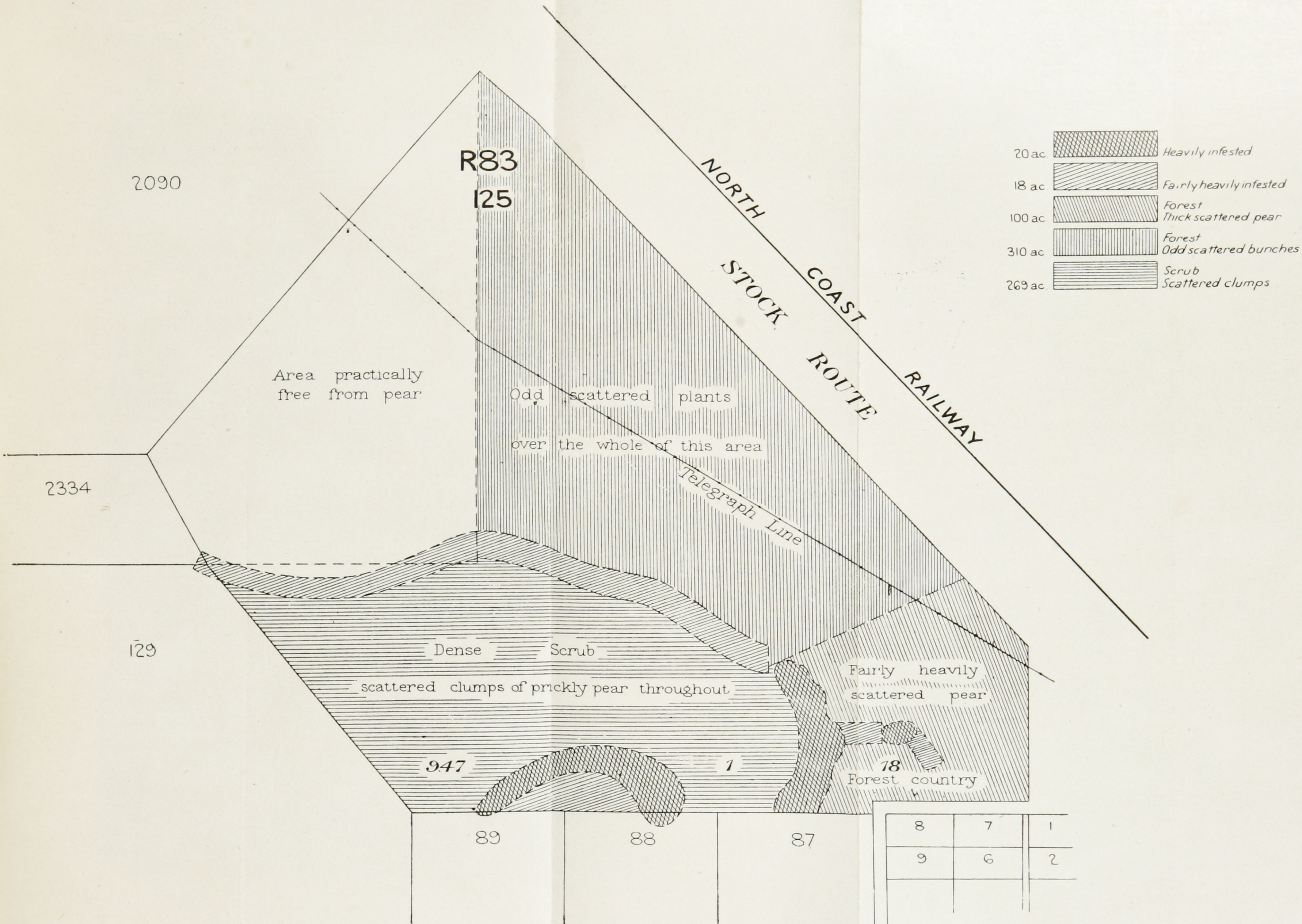

PLATE 15.—Copy of plan of Explosives Magazine Reserve, Bajool. Prepared by Mr. L. G. Rawson.

destroying characteristics most probably rests. In respect of this solubility, it differs from the majority of the arsenic-containing specifics employed. These experiments include:—

1. Further series, with the object of verifying the results previously stated.

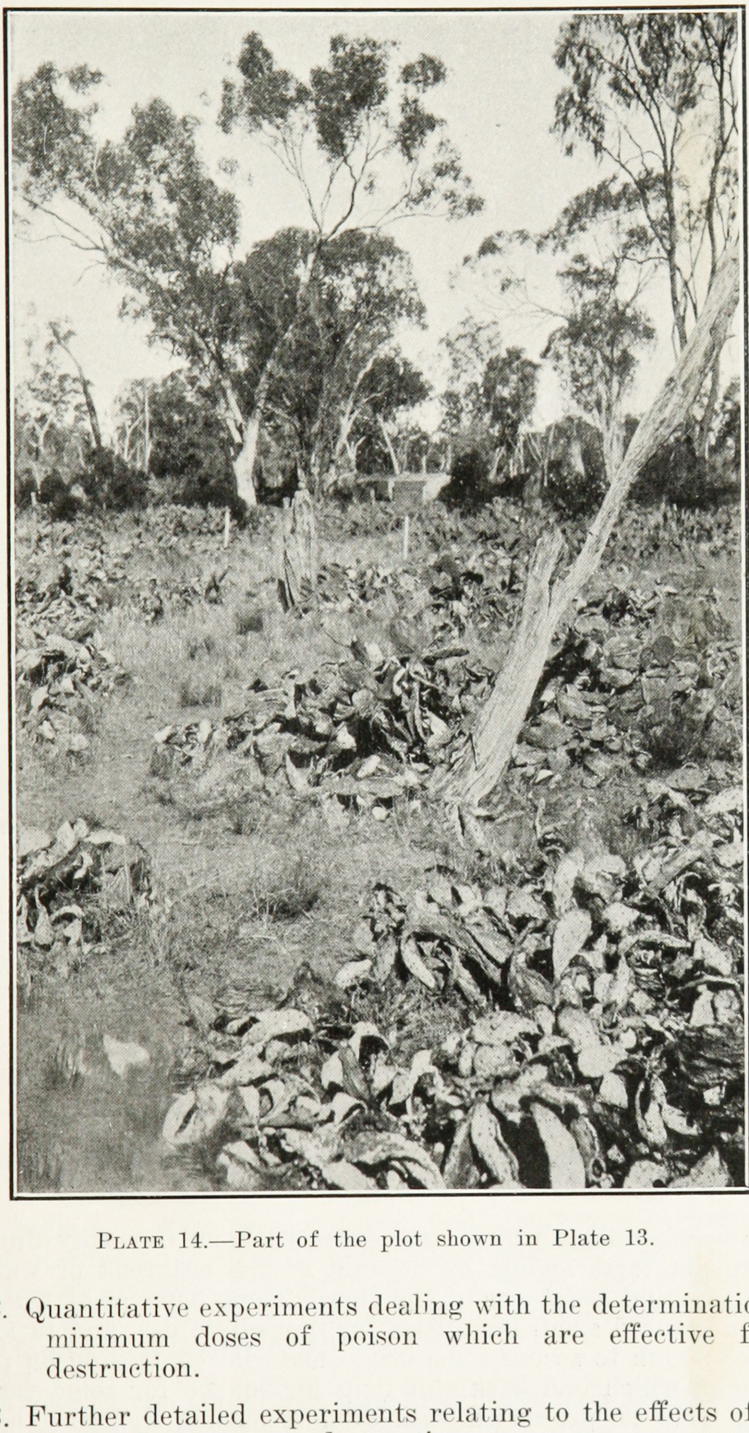

PLATE 14.—Part of the plot shown in Plate 13.

2. Quantitative experiments dealing with the determination of the minimum doses of poison which are effective for pear destruction.

3. Further detailed experiments relating to the effects of climate and seasons on pear destruction.

4. Estimation of the possible deterioration of the soil, due to the presence of poisons, as the result of specifics applied for pear destruction.

Plate 16.—Pear plants growing on the edge of the dense scrub in the Magazine Reserve at Bajool.

For the sake of comparative work, experiments are being performed at regular intervals throughout this year, in which some of the better ones of the other specifics are used.

Considerable delay has been experienced in obtaining a sufficient supply of arsenic acid.

Two consignments which were expected from Germany during last year were not forthcoming, on account of the outbreak of war. It is owing to the kind assistance of the Government Analyst of Queensland, who manufactured small quantities for immediate use, and to my being fortunate enough to secure some crude material containing 66 per cent. arsenic acid, which had been stored in Melbourne for some years, that the work could be proceeded with even to such a limited extent as it was during 1914.

It requires far more extensive trials than have been able to be performed as yet for it to be possible to state as an established fact that arsenic acid is superior to all other pear-killing specifics.

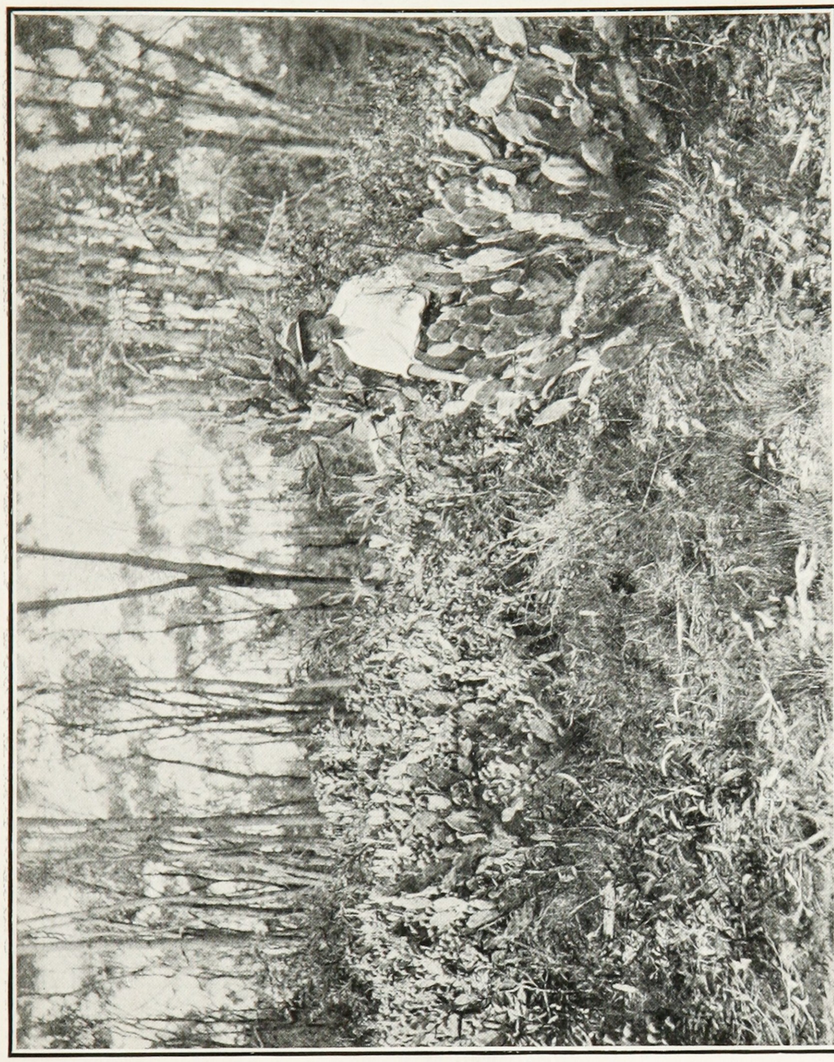

Plate 17.—Pear plants growing on the edge of the thick scrub in the Magazine Reserve at Bajool.

In some instances a few other chemical substances have been added to the arsenic acid, as may have been already noticed in some of the preceding tables. The addition of these substances is purely experimental, and, so far, the plots are not in a sufficiently advanced stage to show whether any permanent advantage is likely to be gained by their presence. The present aspect indicates the contrary. The chief object of employing them is to ascertain whether they will in any way increase the potency or penetrating power of the arsenic acid, or whether the ultimate destruction by burning the poisoned plants would be facilitated to any appreciable extent by them.

I have, fortunately, been able to arrange with a Melbourne firm for the manufacture of one ton of arsenic acid. Since the commencement of

war, the price of arsenic has increased so enormously that the cost of this consignment would not be a fair criterion of its economy as a pear destroyer.

Plate 18.—Pear plants (not yet treated) growing in the thick scrub at Bajool.

Possibility of the Deterioration in Value of the Soil after Clearing by the Application of Poisonous Specifics to the Pear Plants.

This important branch of the subject is receiving considerable attention at present at this station. It is a matter of doubt whether arsenical compounds present in the soil can be absorbed into the root hairs of plants, though the results obtained by me in the series of experiments described on page 25 of this Report indicate that absorption to a limited extent does take place. In any case, the root hairs of plants, which constitute the normal organs of absorption, only ever absorb a very small percentage of any substance present in the soil other than water, so it is unlikely that the arsenic deposited in the soil during the process of pear eradication would prove practically harmful to the cultivation of useful plants in pear-cleared land.

Special series comprising numerous experiments for the investigation of this point are, as has been already stated, in progress at present at the station.

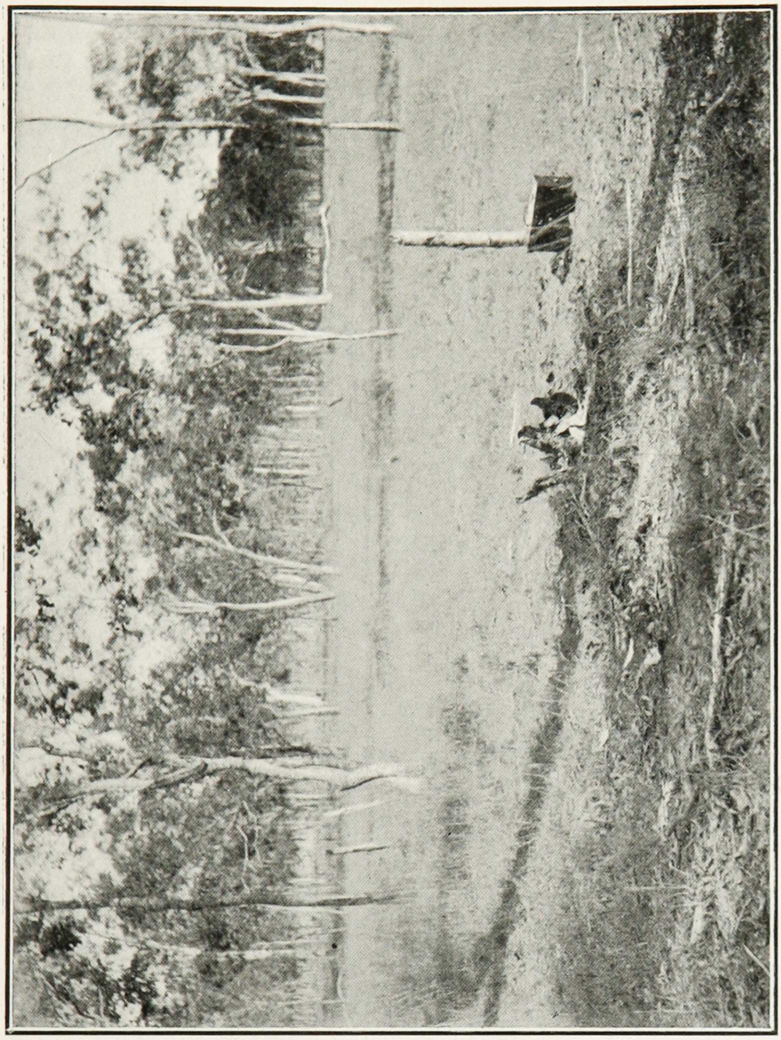

PLATE 19.—Injected pear at Bajool. Most of the plants have completely collapsed; the detached segment and branches are scattered over the foreground.

In September, 1914, three sets of nine plots each were treated as follows:—

Set 1.—Solid injections (6 grams per plant) of arsenic pentoxide were made into six of the plants of this set of plots.

Set 2.—A 3 per cent. solution of arsenic pentoxide was sprayed on to the plants of six plots of this set, half a gallon of the solution being allowed per cwt. of pear treated.

Set 3.—3 oz. of vapour of arsenic trichloride were evolved per cwt. of pear in six plots of this set.

Subsequently these plots were cleared in the following way:—

Set 1, Plot A.—The poisoned pear three months after treatment was burnt up with brushwood. The ash residue was dug into the soil.

Set 1, Plot B.—The poisoned pear three months after treatment was dug into the soil without having been burnt.

Set 1, Plot C.—The pear and soil of this plot were very carefully shielded from poison at the time the other plots were treated. Three months after the treatment of A and B, the uninjured plants were cleared away and the soil dug up.

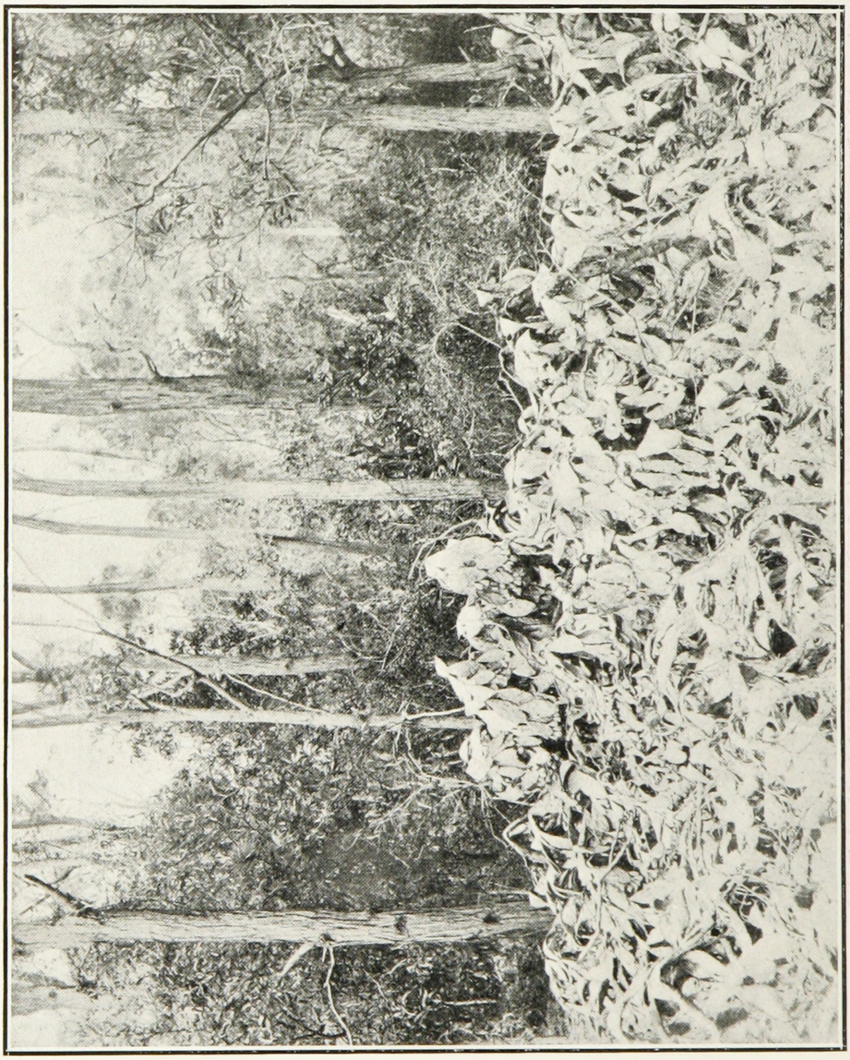

PLATE 20.—Pear plants growing on the edge of the scrub in the Magazine Reserve at Bajool about three weeks after spraying with arsenic acid solution.

Plots A, B, and C were repeated twice again, thus making the 9 plots comprised in Set 1.

Sets 2 and 3 were also similarly treated.

A fall of 40 points of rain at the beginning of this month made the sowing of some of these plots possible.

One set of plots was sown with wheat seed; 5 grams (comprising 135-145 seeds) were used per plot.

In a second set, lucerne was sown; 3 grams of seed were put in per plot.

The season is not a good one for comparative germination experiments owing to the scarcity of rain.

Only a few seeds have germinated in each plot, and the number of seedlings is so variable that there are as yet no results of importance to record.

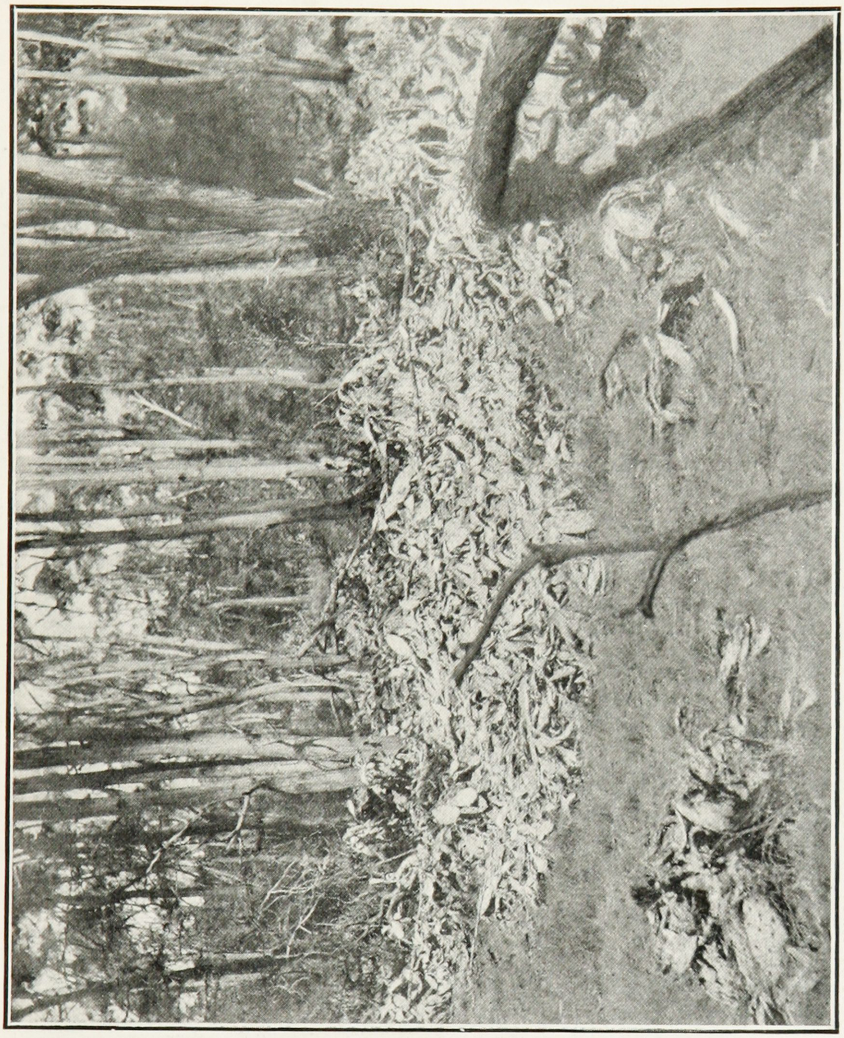

PLATE 21.—Pear at Bajool, sprayed directly after a heavy downfall of rain.

DESTRUCTION OF PRICKLY-PEAR THROUGH THE AGENCY OF PARASITIC INSECTS.

1.—WILD COCHINEAL INSECTS.

PROPAGATION OF THE WILD COCHINEAL INSECTS.

Both *Cocus indicus* (Green) from Ceylon, and *Coccus confusus capensis* (Green) from South Africa have reproduced well, especially during the warmer months of the year, on the small plants of *Opuntia monacantha* placed in the propagation tents in the experimental station reserve.

The multiplication of the insects is so rapid during the summer that it is sometimes a difficult matter to keep a sufficient supply of *Opuntia monacantha* for their food.

At this station there is not one single instance of the sprouting of any of the small *O. monacantha* plants, subsequent to their being attacked by the insects, so presumably their destruction is complete.

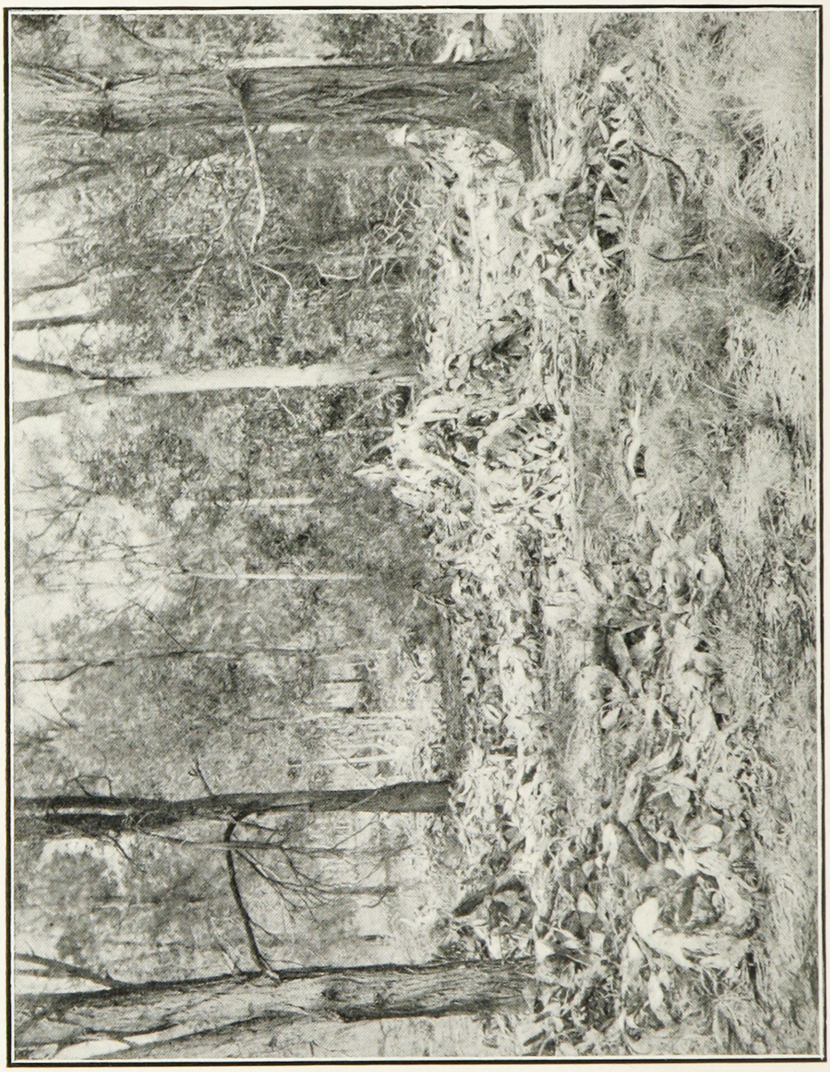

Plate 22.—Pear at Bajool, sprayed directly after a heavy downfall of rain.

EXPERIMENTS PERFORMED IN NORTHERN QUEENSLAND.

In May, 1914, I went to North Queensland for the purpose of ascertaining the amount of damage which the wild cochineal insects of Ceylon would be capable of inflicting on the large plants of *Opuntia monacantha.*

A visit had previously been paid to the *Opuntia monacantha* infested areas by Mr. Temple Clark, who, after inspecting the different localities, suggested the establishment of the insect stations in Bowen and Charters Towers. I accordingly proceeded to Bowen, and, with the help of Mr. G. E. Wright, Crown Lands Ranger, selected a very large bunch of pear in a tomato orchard owned by Mr. Clarke. The clump chosen was

isolated from any other pear plants, and was nearly surrounded by tomato vines. A hessian tent 23 feet 4 inches square and 12 or 14 feet high was constructed, which just easily enclosed the clump of pear. About twenty-five masses of *Coccus indicus* (Green) were distributed amongst the younger segments. The tent door was locked, and the experiment put in charge of Mr. Wright.

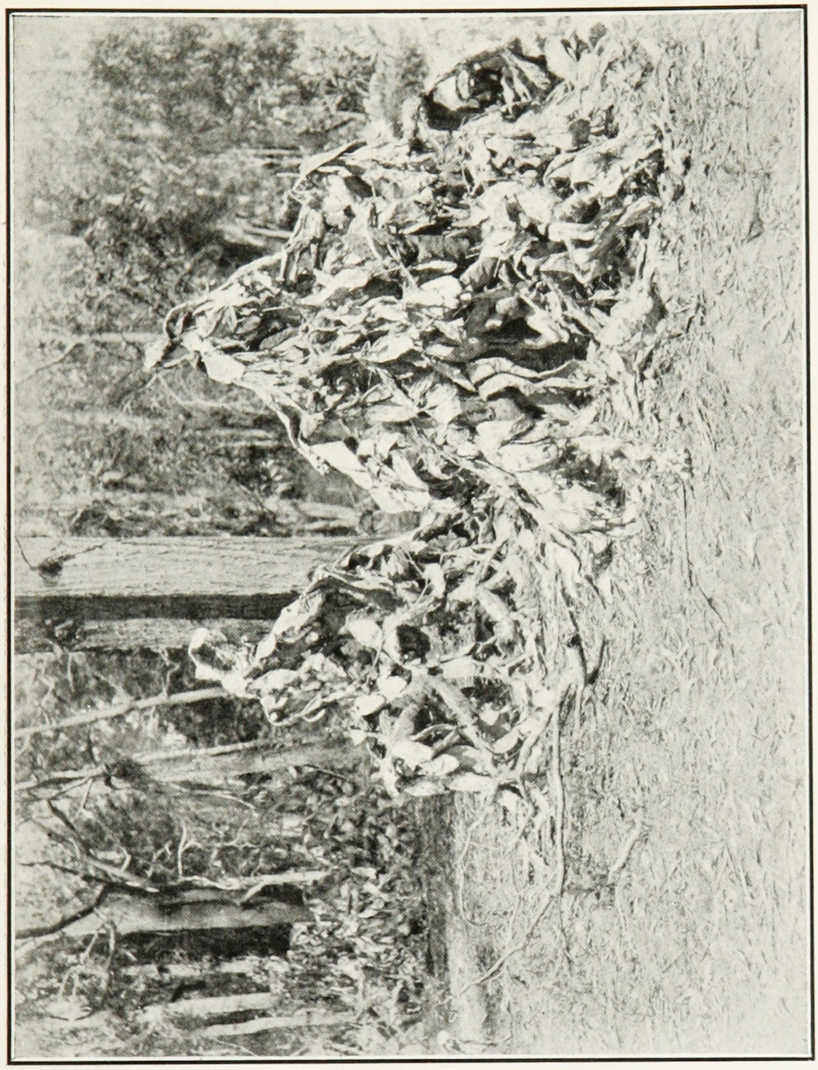

PLATE 23.—Pear Plants at Bajool, sprayed prior to a heavy downfall of rain.

From Bowen I went to Charters Towers, and with the assistance of Mr. E. W. Quirk, Crown Lands Ranger, chose an isolated clump of *Opuntia monacantha,* situated well above flood level, for the experiment. The tent was constructed after the same plan as that erected at Bowen, but owing to the greater size of the pear clump selected, it was necessary to increase the dimensions. In the vicinity of Sandy Creek, the *Opuntia monacantha* species grows luxuriantly and abundantly, and it is estimated that several thousands of pounds would be required to rid that district from the pest by the well-known arsenite of soda poisoning method.

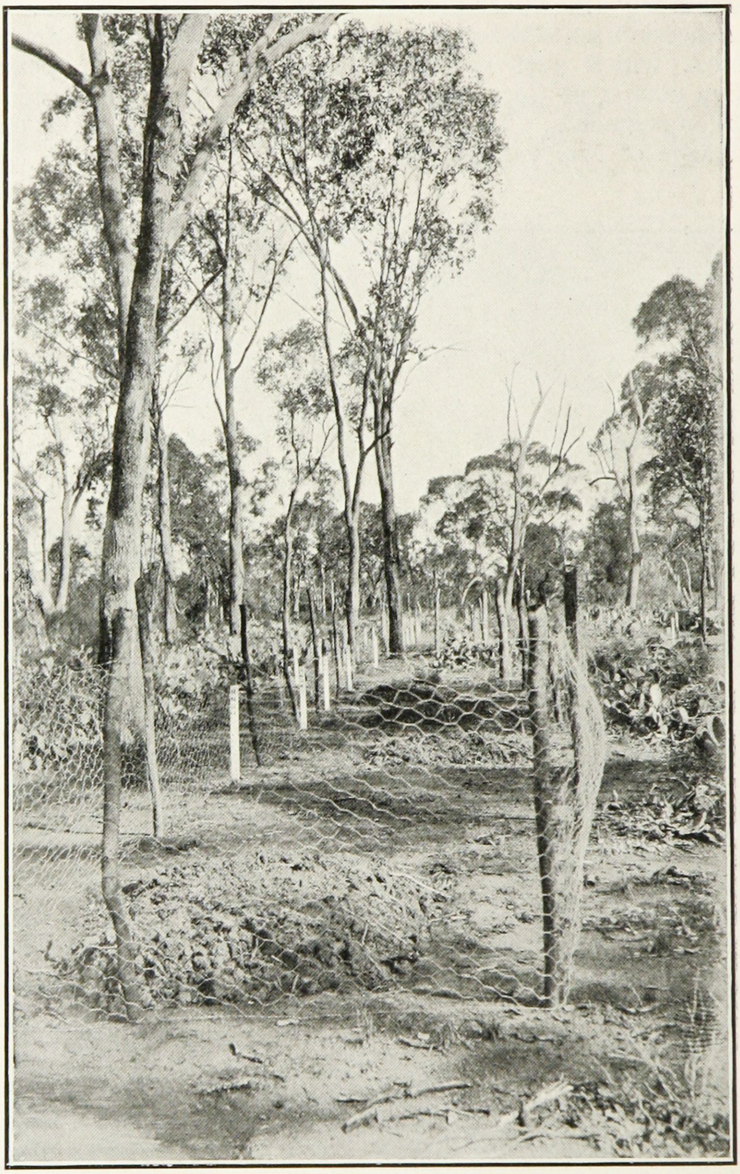

PLATE 24.—Photograph showing fenced-in plots, prepared for sowing with wheat and lucerne, to test the effect of the use of poisonous specifics applied to pear on the soil.

Similar precautions were adopted as in the Bowen experiment, and it was put in the care of Mr. Quirk.

Reports as to the progress of these experiments at Bowen and Charters Towers have been received at more or less regular intervals from the officers in charge. The principal information contained in these reports is as follows:—

July and August, 1914—Reproducing very slowly in both places.

October, 1914—Reproducing fairly well in both places. A few segments completely destroyed by insects.

November, 1914—Reproducing very quickly. A few large branches completely destroyed.

January, 1915—Nearly the whole of the clump in both localities destroyed by the insects.

At the beginning of the present month I visited the insect stations in both places. The results of the experiments are most satisfactory. Practically all parts of the large clumps are destroyed. At Charters

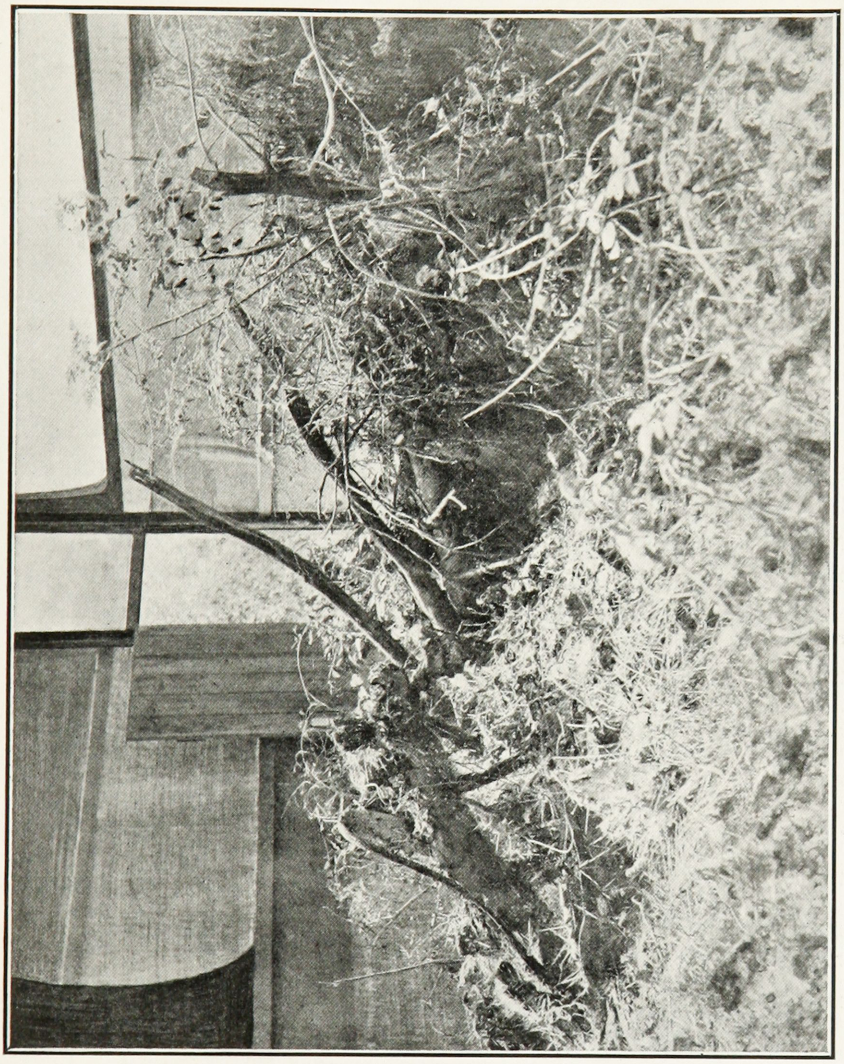

PLATE 25.—Interior of cochineal tent at Bowen, April, 1915. In May, 1914, the pear almost filled the tent.

Towers the destruction appears to be quite complete; at Bowen about 3 feet of the large main stem (about 12 by 6 inches) is still standing, and has some green undecayed patches, but the process of rotting appears to be spreading fast all over it. Otherwise, the whole plants are dried up, and consist practically entirely of fibre. Four new sprouts were projecting from the undecayed portions of the main stem mentioned above, but these are now covered with cochineal insects, and are already exhibiting the first signs of decay. Cochineal insect-bearing segments

were removed from the tent at Charters Towers, and thrown into the centres of several very large clumps of *Opuntia monacantha* growing along the banks of Sandy Creek.

I was surprised and very sorry to see a colony of young plants of the Dulacca pest pear spreading over the Millchester district in Charters Towers. The ranger informs me that it stretches for several miles along the bank of the creek. The eradication of this pear, which I am informed occurs on land under the control of the Mines Department, is a matter of utmost importance, and should be undertaken immediately.

Plate 26.—Interior of cochineal tent at Bowen.

Propagation of Wild Cochineal Insects on the Different Species of Prickly-Pears Occurring in Queensland.

Experiments in this direction were commenced early in 1914.* At intervals of four weeks, masses of *Coccus indicus* (Green) were attached to the young segments of different species of prickly-pear growing in isolated tents.

* Annual Report, Department of Public Lands, Queensland, 1913, pp. 73 and 74.

Though, for longer than a year, every opportunity has been afforded for the insects to attack these plants, the attempts have, up to the present time, always terminated in failure, and the present aspect indicates that there is no possibility of acclimatising the insects and inducing them to multiply on and ultimately destroy the Dulacca pest pear, nor any of the other species on to which they were attached.

PLATE 27.—Interior of cochineal tent at Charters Towers.

THE POSSIBILITY OF COCCUS INDICUS (GREEN) EVENTUALLY ATTACKING USEFUL PLANTS.

In my last Report† I mentioned a number of useful plants, on to which I was endeavouring to acclimatise the wild cochineal insects from Ceylon. As the insect masses placed on these plants died off, they were replaced by other living masses. This was continued until the plants were killed by severe frosts. In not one instance was an insect exhibiting any sign of vitality whatever observed on the plants or fruits, after the drying up of the small portion of *Opuntia monacantha* segments on which the cochineals were established, and which had been fixed on to useful plants.

Additional experiments in this direction have been carried out. Living masses of *Coccus indicus* were transferred on to turnips, French

† Annual Report, Department of Public Lands, Queensland, 1913, page 76.

and broad beans, peas, marrows, rock and water melons, maize, lucerne, wheat, grape vines, passion fruit, potatoes, tomatoes, and cucumbers. In every case attempts to propagate the insects have ended in failure.

Further evidence of the inability of the wild cochineal insects to subsist on plants other than *Opuntia monacantha* is afforded by the experiment carried out at Bowen.

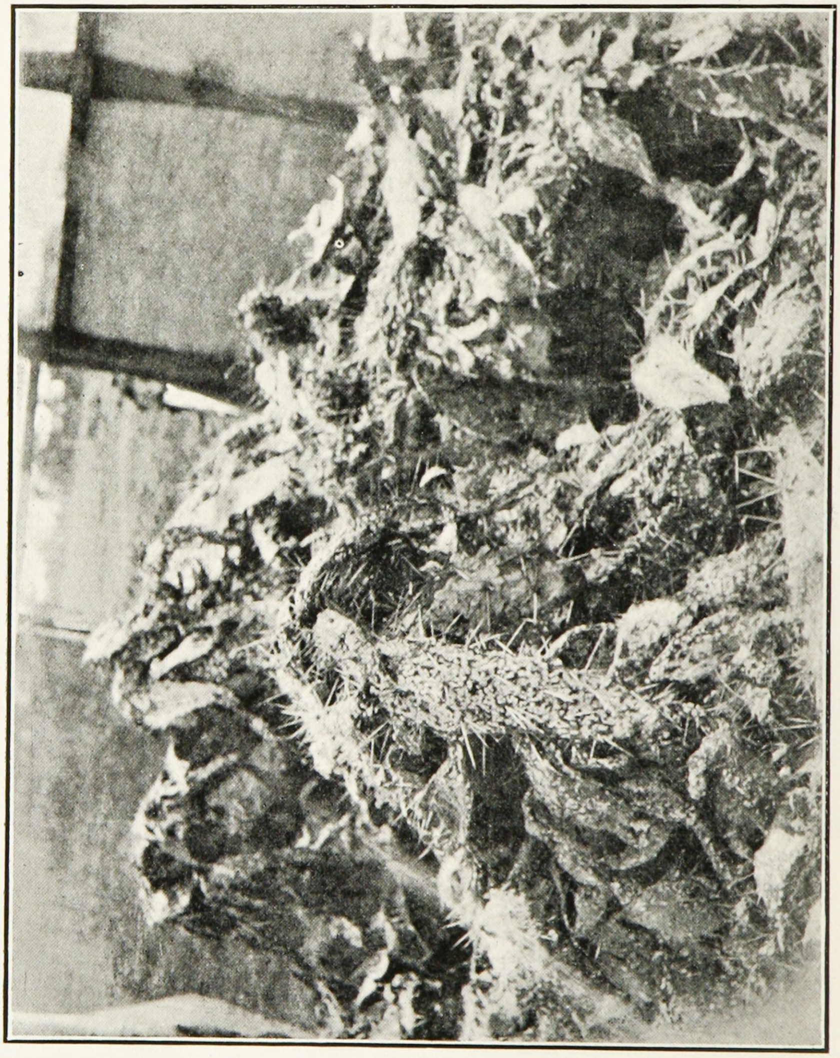

PLATE 28.—Interior of the cochineal tent at Charters Towers.

Several different species of plants, infested with various kinds of insects, were growing inside the insect tent amongst the clump of pear.

Amongst these insects, which were kindly identified by Mr. Henry Tryon, larvæ of the wild cochineals were observed. Mr. Tryon stated that these larvæ were all of the same age, and showed no indication whatever of having obtained nourishment from any of the plants except *Opuntia monacantha*.

2.—ZOPHODIA, sp.

An account of this insect is given in the Report of the Prickly Pear Travelling Commission, Queensland, page 105.

Up till the present date, no specimens have been received at this station.

FUNGAL GROWTHS ON DULACCA PEST PEAR.

Hormodendron.

In September, 1914, two peculiar spoke-like fungal growths were found on two segments of Dulacca pest pear. The infested segments did not appear to be injured in any way by the organism. One of the specimens was forwarded to the Royal Botanic Gardens, Kew.

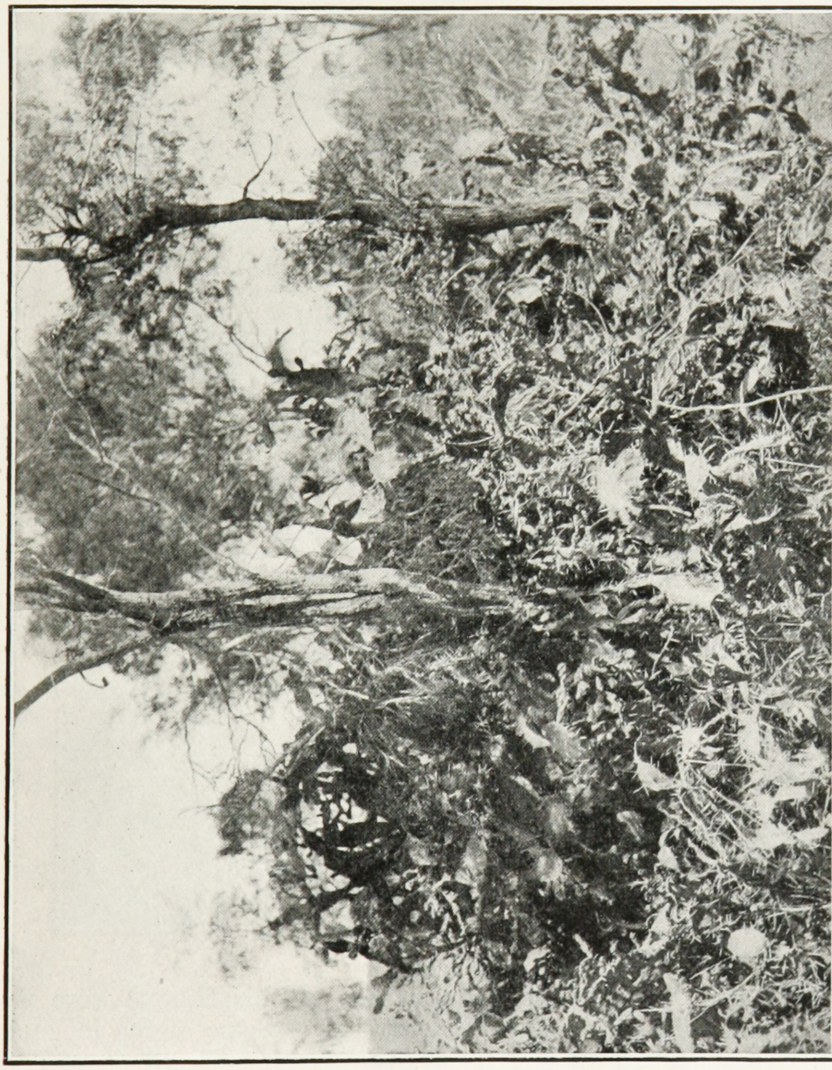

Plate 29.—*Opuntia monacantha* growing at Charters Towers.

Here it was identified as the secondary conidial stage (Hormodendron) of some species of *Cladosporium*. It is a parasitic condition of the fungus, and often proves very destructive to vegetation.*

I have not since found any specimens of Hormodendron, and its occurrence is probably simply a matter of scientific interest.

* An. Bot., volume xxiv., page 360.

Shot Hole Fungus.

On 18th July, 1914, I received from the Secretary of the Prickly Pear Board cultures labelled *Gloeosporium lunatum,* which had been procured in America by the members of the Travelling Commission.

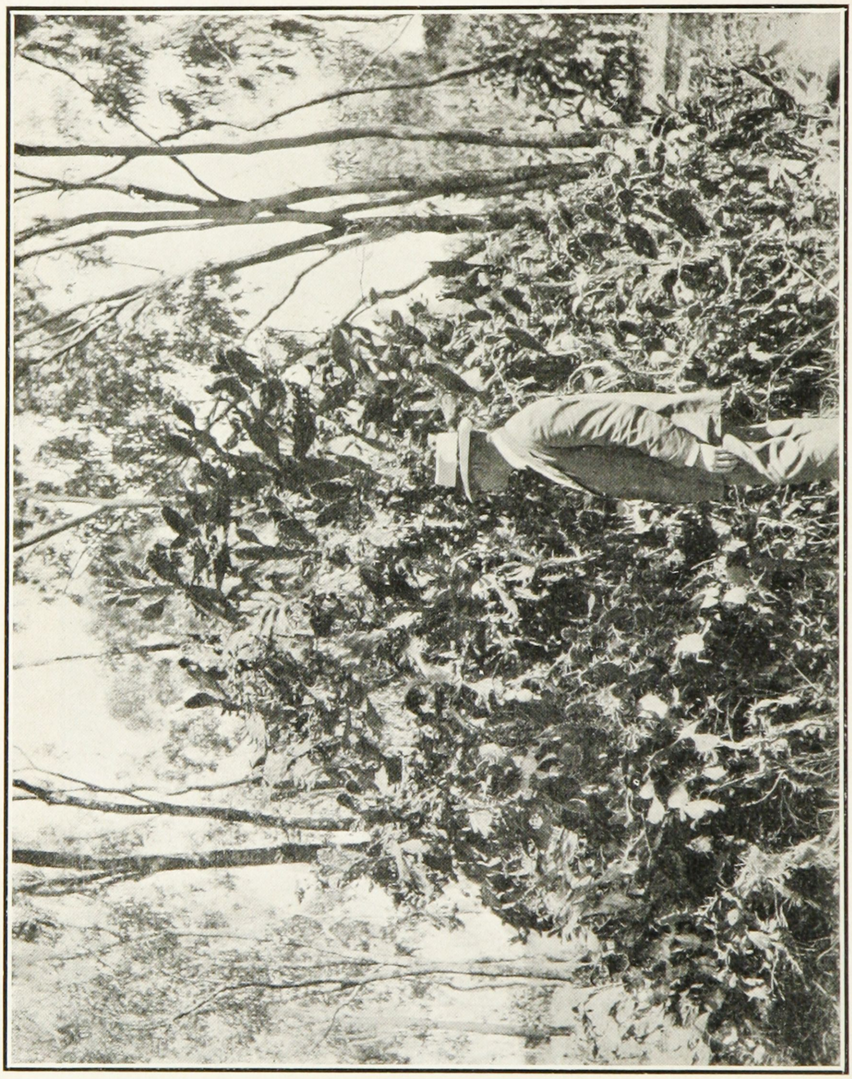

Plate 30.—Clumps of *Opuntia monacantha* growing at Charters Towers. A few masses of *Coccus indicus* (Green) were thrown into this clump in April, 1915.

On 20th July, hypodermal inoculations of this fungus were made into several segments of the Dulacca pest pear. Some of the inoculated segments were enclosed in a bell jar, the surface of which was kept damp as well as it was possible to do so. The remainder of the inoculated segments were loosely surrounded with two thicknesses of cheesecloth, which was saturated with water twice a day for some weeks. All the inoculated segments were examined in December, 1914, but no sign of fungal growth was apparent.

A similar experiment was commenced in December, 1914, but, as in the last series, negative results were yielded.

Practically all the cultures in the tubes have become dried up. The failure of these experiments may also be due to the abnormally dry conditions prevailing.

During the year there have been many visitors to the Experimental Station, including a number of members of the British Association for the Advancement of Science, a large Parliamentary party, led by the Hon. Jas. Tolmie, M.L.A., Minister for Lands, and a great many graziers, farmers, and selectors.

In conclusion, I wish to thank the officers of the different Government Departments and Universities of Queensland and Victoria, Professor Lawson of Sydney University, Mr. J. H. Maiden, Director of the Sydney Botanic Gardens, Mr. Clarke of Bowen, the directors of various experimental stations in America, the Director of the Royal Botanic Gardens, Kew, England, and all others who have kindly assisted the Experimental Station during the year.

I have, &c.,

JEAN WHITE-HANEY,

Officer in charge of the Prickly-Pear Experimental Station.

Dulacca, Queensland.

Anthony James Cumming, Government Printer, Brisbane.